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THE U.S. RECLAMATION SERVICE

SERVICE MONOGRAPHS
OF THE
UNITED STATES GOVERNMENT
No 2

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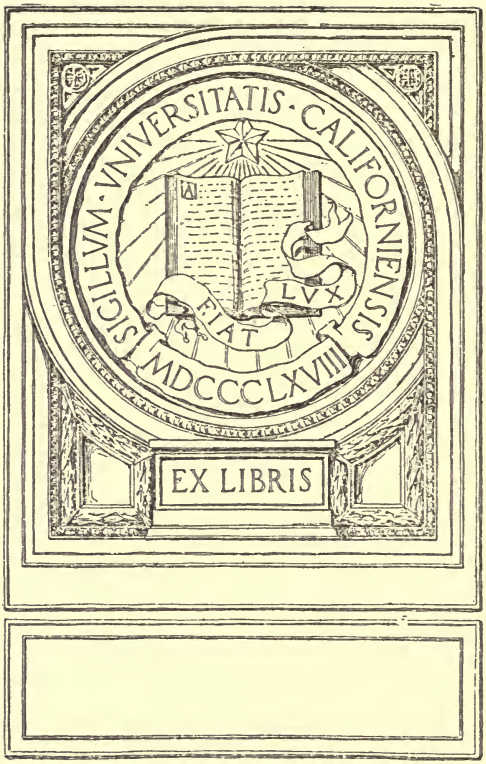
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THE U. S. RECLAMATION SERVICE

ITS HISTORY, ACTIVITIES AND ORGANIZATION

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SERVICE MONOGRAPHS OF THE UNITED STATES GOVERNMENT

The Reclamation Service

The United States Geological Survey (In press)

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OF THE
UNITED STATES GOVERNMENT
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ITS HISTORY, ACTIVITIES AND ORGANIZATION

D. APPLETON AND COMPANY
NEW YORK LONDON
1919

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THE INSTITUTE FOR GOVERNMENT RESEARCH

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The Institute for Government Research is an association of citizens for coöperating with public officials in the scientific study of government with a view to promoting efficiency and economy in its operations and advancing the science of administration. It aims to bring into existence such information and materials as will aid in the formation of public opinion, and will assist officials, particularly those of the national government, in their efforts to put the public administration upon a more efficient basis.

To this end, it seeks by the thoroughgoing study and examination of the best administrative practice, public and private, American and foreign, to formulate those principles which lie at the basis of all sound administration, and to determine their proper adaptation to the specific needs of our public administration.

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FOREWORD

The first essential to efficient administration of any enterprise is full knowledge of its present make-up and operation. Without full and complete information before them, as to existing organization, personnel, plant, and methods of operation and control, neither legislators nor administrators can properly perform their functions.

The greater the work, the more varied the activities engaged in, and the more complex the organization employed, the more imperative becomes the necessity that this information shall be available—and available in such a form that it can be readily utilized.

Of all undertakings, none in the United States, and few, if any, in the world, approach in magnitude, complexity, and importance that of the national government of the United States. As President Taft expressed it in his message to Congress of January 17, 1912, in referring to the inquiry being made under his direction into the efficiency and economy of the methods of prosecuting public business, the activities of the national government "are almost as varied as those of the entire business world. The operations of the Government affect the interest of every person living within the jurisdiction of the United States. Its organization embraces stations and centers of work located in every city and in many local subdivisions of the country. Its gross expenditures amount to nearly $1,000,000,000 annually. Including the personnel of the military and naval establishments, more than 400,000 persons are required to do the work imposed by law upon the executive branch of the Government.

"This vast organization has never been studied in detail as one piece of administrative mechanism. Never have the foun-

dations been laid for a thorough consideration of the relations of all of its parts. No comprehensive effort has been made to list its multifarious activities or to group them in such a way as to present a clear picture of what the Government is doing. Never has a complete description been given of the agencies through which these activities are performed. At no time has the attempt been made to study all of these activities and agencies with a view to the assignment of each activity to the agency best fitted for its performance, to the avoidance of duplication of plant and work, to the integration of all administrative agencies of the Government, so far as may be practicable, into a unified organization for the most effective and economical dispatch of public business."

To lay the basis for such a comprehensive study of the organizations and operations of the national government as President Taft outlines, the Institute for Government Research has undertaken the preparation of a series of monographs, of which the present study is one, giving a detailed description of each of the fifty or more distinct services of the Government. These studies are being vigorously prosecuted, and it is hoped that all services of the Government will be covered in a comparatively brief space of time. Thereafter, revisions of the monographs will be made from time to time as need arises, to the end that they may, as far as is practicable, represent current conditions.

These monographs are all prepared according to a uniform plan. They give: First, the history of the establishment and development of the service; second, its functions, described not in general terms, but by detailing its specific activities; third, its organization for the handling of these activities; fourth, the character of its plant; fifth, a compilation of, or reference to, the laws and regulations governing its operations; sixth, financial statements showing its appropriations, expenditures and other data for a period of years; and finally, a full bibliography of the sources of information, official and private, bearing on the service and its operations.

In the preparation of these monographs the Institute has kept steadily in mind the aim to produce documents that will be of direct value and assistance in the administration of public affairs. To executive officials they offer valuable tools of administration. Through them, such officers can, with a minimum of effort, inform themselves regarding the details, not only of their own services, but of others with whose facilities, activities and methods it is desirable that they should be familiar. Under present conditions services frequently engage in activities in ignorance of the fact that the work projected has already been done, or is in process of execution by other services. Many cases exist where one service can make effective use of the organization, plant or results of other services had they knowledge that such facilities were in existence. With the constant shifting of directing personnel that takes place in the administrative branch of the national government, the existence of means by which incoming officials may thus readily secure information regarding their own and other services is a matter of great importance.

To members of Congress the monographs should prove of no less value. At present these officials are called upon to legislate and appropriate money for services concerning whose needs and real problems they can secure but imperfect information. That the possession by each member of a set of monographs, such as is here projected, prepared according to a uniform plan, will be a great aid to intelligent legislation and appropriation of funds, can hardly be questioned.

To the public, finally, these monographs will give that knowledge of the organization and operations of their government which must be had if an enlightened public opinion is to be brought to bear upon the conduct of government affairs.

These studies are wholly descriptive in character. No attempt is made in them to subject the conditions described to criticism, nor to indicate features in respect to which changes might with advantage be made. Upon administrators themselves falls responsibility for making or proposing changes

which will result in the improvement of methods of administration. The primary aim of outside agencies should be to emphasize this responsibility and facilitate its fulfillment.

While the monographs thus make no direct recommendations for improvement, they cannot fail greatly to stimulate efforts in that direction. Prepared as they are according to a uniform plan, and setting forth as they do the activities, plant, organization, personnel and laws governing the several services of the government, they will automatically, as it were, reveal, for example, the extent to which work in the same field is being performed by different services, and thus furnish the information that is essential to a consideration of the great question of the better distribution and coördination of activities among the several departments, establishments and bureaus, and the elimination of duplications of plant, organization and work. Through them it will also be possible to subject any particular feature of the administrative work of the government to exhaustive study, to determine, for example, what facilities, in the way of laboratories and other plant and equipment, exist for the prosecution of any line of work and where those facilities are located; or what work is being done in any field of administration or research, such as the promotion, protection and regulation of the maritime interests of the country, the planning and execution of works of an engineering character, or the collection, compilation and publication of statistical data, or what differences of practice prevail in respect to organization, classification, appointment, and promotion of personnel.

To recapitulate, the monographs will serve the double purpose of furnishing an essential tool for efficient legislation, administration and popular control, and of laying the basis for critical and constructive work on the part of those upon whom responsibility for such work primarily rests.

Whenever possible the language of official statements or reports has been employed, and it has not been practicable in all cases to make specific indication of the language so quoted.

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THE U. S. RECLAMATION SERVICE

CHAPTER I

HISTORY

The Reclamation Service is a civil engineering organization of the federal government in the Department of the Interior. Its functions are to examine, survey, construct and maintain irrigation works for the storage, diversion, and distribution of water for the reclamation of arid and semiarid lands in the western part of the United States.

The arid regions of the United States, as generally designated, include about two-fifths of its entire area, extending from about the middle of the continent westerly nearly to the Pacific Ocean. There are no sharply marked lines or divisions between the arid and the humid areas, but there is, especially near the center of the United States, a broad intermediate belt, neither distinctly arid nor distinctly humid, which is called the subhumid or semiarid region. This belt extends over North Dakota, South Dakota, western Nebraska, and western Kansas into Oklahoma and the panhandle of Texas. In years of excessive moisture the subhumid region sometimes creeps up toward the foothills of the Rocky Mountains, while during dry years the greater part of the plains region west of the Missouri becomes semiarid.

Water is available to irrigate only a small portion of the total area of the arid regions. Estimates vary as to the size of the area which can be irrigated. In the first annual report

of the Reclamation Service it is stated that "under the most complete system of irrigation possible it is probable that not over five per cent. of the arable land can be irrigated in any one of the western states."

For a full understanding of the origin and development of the Reclamation Service and of the laws under which it operates, some account is necessary of the conditions surrounding early private reclamation enterprises in this country, and of the previous policy of the national government toward reclamation of the public lands. This account falls under the following heads:

1. Irrigation development prior to 1880.
2. Legislation relative to private irrigation works on the public lands, 1866-1901.
3. Reclamation of the public lands by the states, 1894 to date.

Irrigation Development Prior to 1880. Irrigation of arid lands of the West dates back far before the historic period. Remains of irrigation canals and distributing systems are found, notably in Arizona and adjacent states, in proximity to the ruins of the habitations built by the Pueblo or town-dwelling Indians. The Spanish conquerors coming northerly from Mexico enlarged the works of the natives or built new canals to bring water to the fields surrounding their settlements. The first English speaking people to adopt the art were the small party of Mormon pioneers who, in the summer of 1847, settled in the Great Salt Lake Valley. Their systematic reclamation of the surrounding areas served as an object lesson for larger undertakings.

In the decade 1870-1880, the practice of irrigation in this country was greatly advanced by the success of several coöperative colonization enterprises in northeastern Colorado. Of these the first and best known was the Union Colony at Greeley, the organizers of which were familiar with the methods employed in Utah. So successful were these colonies that they

were said to have "made of northeastern Colorado one of the most vigorous agricultural districts of the country." [1]

There are no reliable statistics as to the extent of early irrigation development, but the available information indicates that from a few thousand acres in 1850 there was steady increase to approximately 50,000 acres in 1860, and possibly 200,000 acres in 1870, followed by rapid development, so that approximately 1,000,000 acres produced hay and cultivated crops in 1880.

Legislation Relative to Private Irrigation Works on the Public Lands, 1866-1901. The peculiar conditions of water supply existing in the arid region had early given rise to special legislation in all of the states and territories in that region regulating the rights of private enterprises to the use of water. In 1866, the first legislation relative to water rights on the public lands was enacted by Congress. By act of July 26, 1866 (sec. 9, 14 Stat. L., 253),[2] rights to the use of water on the public lands vested under local laws and customs were confirmed.[3] Although the enactment of this provision was due primarily to the needs of the hydraulic mining industry, its language was drawn to embrace also the use of water for "agricultural, manufacturing, or other purposes."

Positive action in the direction of securing irrigation of the arid lands for agricultural purposes was first taken in 1875. By an act of March 3, 1875 (18 Stat. L., 497), provision was made for the disposition of the arid lands, termed by the act "desert lands," of Lassen County, California, to entrymen who would irrigate them.

Two years later, by the so-called "desert land law" (act of March 3, 1877, 19 Stat. L., 377), this policy was extended to

[1] Widtsoe, Principles of Irrigation Practice, p. 461.

[2] Now section 2339, Revised Statutes.

[3] By section 17 of the act of July 9, 1870 (16 Stat. L., 218), now section 2340, Revised Statutes, all patents, preëmptions and homesteads allowed were made subject to such vested and allowed water rights.

the states of California, Oregon, and Nevada, and the territories of Washington, Idaho, Montana, Utah, Wyoming, Arizona, New Mexico, and Dakota. The act provided for the sale, at $1.25 per acre, of not more than 640 acres of desert lands to any person who had filed a declaration of intention to become a citizen, upon condition that he irrigate the lands, three years being allowed him for this purpose. "Desert lands" were defined by the act to be "all lands, exclusive of timber lands and mineral lands which will not, without irrigation, produce some agricultural crop."

In 1891 (sec. 2, act of March 3, 1891, 26 Stat. L., 1095), the desert land act was extended to the state of Colorado and was modified to permit two or more persons to "associate together in the construction of canals and ditches for irrigating and reclaiming" their tracts under a joint plan. The provision for proof of irrigation was, however, made much more severe, it being required that the entryman expend, in each of the three years allowed for reclamation, not less than one dollar per acre "in the necessary irrigation and cultivation thereof, by means of main canals and branch ditches and in permanent improvements upon the land, and in the purchase of water rights for the irrigation of the same." In addition, proof of the cultivation of one-eighth of the land within the three year period was required.

In the same act there was for the first time extended to irrigation works a policy which had long before been adopted with reference to roads and railroads through the public lands. By sections 18 to 21 of the act there was granted "to any canal or ditch company formed for the purpose of irrigation," and to any individual or association of individuals constructing canals, ditches or reservoirs for that purpose, "the right of way through the public lands and reservations of the United States . . . to the extent of the ground occupied by the water of the reservoir and of the canal and its laterals, and fifty feet on each side of the marginal limits thereof; also the right to take from the public lands adjacent to the line of the canal or

ditch, material, earth and stone, necessary for the construction of such canal or ditch."

In 1901, by act of February 15 (31 Stat. L., 790), the grant of rights of way over the public lands for water works was extended so as to include the conveyance of water for almost every purpose. The Secretary of the Interior was empowered "to permit the use of rights of way through the public lands, forest and other reservations" and through certain national parks, "for canals, ditches, pipes and pipe lines, flumes, tunnels, or other water conduits, and for water plants, dams, and reservoirs used to promote irrigation or mining or quarrying, or the manufacturing or cutting of timber or lumber,[1] or the supplying of water for domestic, public, or any other beneficial uses."

Reclamation of the Public Lands by the States, 1894 to Date. Within a few years after the passage of the act of 1891, which may be regarded as the most important single enactment relative to the reclamation of the public lands by private enterprise, provision was made by Congress for reclamation by public land states. By section 4 of the sundry civil appropriation act of August 18, 1894 (28 Stat. L., 422), commonly known as the Carey Act, the government offered to contract with any of the states containing arid lands, binding itself "to donate, grant and patent to the State free of cost for survey or price such desert lands, not exceeding one million acres in each State, as the State may cause to be irrigated, reclaimed, occupied, and not less than twenty acres of each one hundred and sixty acre tract cultivated by actual settlers, within ten years next after the passage of this act."

Two years later, by act of June 11, 1896 (29 Stat. L., 434), the scope of the act was extended by providing that patents should issue to a state for any particular tract of land re-

[1] Rights of way for canals and reservoirs for "the business of mining or quarrying or of cutting timber and manufacturing lumber" had already been granted by the act of January 21, 1895 (28 Stat. L., 635).

claimed under the act "when an ample supply of water is actually furnished in a substantial ditch or canal or by artesian wells or reservoirs, without regard to settlement or cultivation." [1]

On March 3, 1901 (31 Stat. L., 1188), Congress extended the terms of this law, which had been limited to ten years from the date of its original passage, so that it should remain in continued operation, allowing ten years for the reclamation of each body of land segregated thereunder.

In the eight years which elapsed between the enactment of the Carey Act and that of the Reclamation Act, but seven of the states covered by the Carey Act took any steps to take advantage of its provisions. Out of the total area of 7,000,000 acres open to them for filing, these states had made application for less than 1,200,000 acres. Only four of the states had, however, filed their applications in approved form, their applications covering less than 600,000 acres, and of these only one state, Wyoming, had filed proper proofs of reclamation, as required by the law, as to any of the land applied for; so that the 11,321 acres patented to that state constituted the whole of the net results of the Carey Act during the first eight years of its operation.

In the twenty-three years from the passage of the act to June 30, 1917, ten states in all made applications under the act, but of these only six filed proofs of reclamation resulting in patent. To these a total of slightly more than 800,000 acres was patented, and of this over 520,000 acres were patented to Idaho, and over 150,000 to Wyoming. Of the remaining 130,727 acres, 62,718 were patented to Oregon, 30,683 to Montana, 25,814 to Utah, and 11,511 to Colorado.

It thus appears that but few of the states have taken extensive action to obtain the benefits contemplated by the Carey

[1] By this act also the states were authorized to create a lien against all lands reclaimed "for the actual cost and necessary expenses of reclamation and reasonable interest thereon from the date of reclamation until disposed of to actual settlers," such lien to be "valid on and against the separate legal subdivisions of land reclaimed."

Act. During the last ten years little activity has been displayed in the construction of reclamation works under this act, because of the fact that most of these projects have been financially unprofitable to the investors.

In 1912, a committee was appointed by the Secretary of the Interior to report upon the historical and current conditions of Carey Act projects. The report, rendered under date of February 15, 1913,[1] states that much actual development has been accomplished. The failure to accomplish still more is attributed by the report to improper administration of the act by the states and improper management by the promoters of the several projects. In particular the report criticizes the segregation of lands for long periods of time at the request of promoters, the segregation of lands having insufficient water supply, the underestimation of the cost of irrigation works, carelessness and inefficiency, and in some cases dishonesty on the part of state officials in their supervision of the work of construction, improper methods of disposing of the lands, resulting in their appropriation by speculators rather than actual settlers, and the imposition of unduly burdensome water rates. The report concludes:

The chief obstacle in the way of Carey Act projects at present is a general lack of confidence on account of past failures, resulting in inability to secure financial backing. When a market for Carey Act bonds is found, it is generally at a price to the developing company of 80 to 85, thus making the cost of money to the company at the rate of 7 per cent or more on the basis of a 6 per cent bond, and in addition requiring the redemption payment for the bond to be from 20 to 25 per cent greater than the original proceeds. The cost of colonization, which is a surprisingly large item in undertakings of this character; the cost of administration during a period of 20 years more or less, from the beginning of construction until the last deferred payments have been made by settlers; the cost for interest for the period of investigation and con-

[1] This report was prepared by Herman Stabler, of the U. S. Geological Survey, P. R. Dudley, of the Land Office, and F. W. Hanna, of the U. S. Reclamation Service, and was printed as Senate Document No. 1097, 62d Congress, 3d Session.

struction and until the interest on settlers' notes is sufficient to offset the bond interest; and a profit, even though small, for the developing company and the people who have taken the risks of the development, increase the cost of the land to the settler, under even the best projects of this character, to an amount in the neighborhood of twice the actual construction cost.

It is evidently not possible under any scheme of financing and development to remove all of these items of cost from irrigated land. Under the Government projects of the Reclamation Service the items of interest and profit have been eliminated, but the costs of colonization and administration remain, in addition to the actual costs of construction. It has been suggested that the same items could be reduced under the Carey Act by the States lending their credit to the projects and supervising their development in such manner as to assure successful development under reasonable conditions.

Movement for National Construction of Reclamation Works, 1878-1902. During the whole of the period covered by the legislation outlined in the preceding sections for the development of the arid lands by private enterprise and by state action, there had been carried on, by members of Congress, by officials of the government, and by private citizens, individually and in associations, a movement for the more direct treatment of the problem of reclamation by the national government through the actual construction by it of reclamation works on a large scale.

Among the earliest and most notable of those who took this view was Major John Wesley Powell, who had made an extensive study of the relatively unknown west, his exploration of the Grand Canyon of the Colorado River being particularly notable. His "Report on the land of the arid region of the United States with a more detailed account of the land of Utah, with maps," published in 1878, attracted general attention. Particularly noteworthy was his discussion of the methods to be employed for the redemption of the arid region. He stated that there were involved "engineering problems requiring for their solution the greatest skill. . . . To a great

extent the redemption of all these lands will require extensive and comprehensive plans for the execution of which aggregate capital or coöperative labor will be necessary. Here individual farmers being poor men can not undertake the task. For its accomplishment a wise provision embodied in carefully considered legislation is necessary." He also suggested legislation to authorize the organization of irrigation districts and of pasturage districts, providing in particular "that the right to the water necessary for the redemption of an irrigated farm shall inhere in the land . . . and the right to the water shall pass with the title to the land."

As Director of the United States Geological Survey from 1881 to 1894, Major Powell persistently urged suitable legislation, and in his various writings from 1878 to 1894 he stated definitely that the general government must of necessity deal directly with the irrigation question. His reports were much discussed by those who were interested in the development of the west, and under his frequent and urgent presentations the subject attracted more and more attention from year to year.

Finally, in 1888, his views, which were strongly seconded by several members of Congress, were recognized by Congress to the extent of the authorization of an investigation of the practicability of constructing irrigation reservoirs in the arid region. Several months later an appropriation of $100,000 was made for the work and in the next year an appropriation of $250,000.

The original resolution authorizing the investigation (joint resolution of March 20, 1888, 25 Stat. L., 618), is notable for the clarity with which it defines the irrigation problem. It reads:

Whereas a large portion of the unoccupied public lands of the United States is located within what is known as the arid region, and now utilized only for grazing purposes, but much of which, by means of irrigation, may be rendered as fertile and productive as any land in the world, capable of supporting a large population, thereby adding to the national wealth and prosperity;

Whereas all the water flowing during the summer months in many of the streams of the Rocky Mountains, upon which the husbandman of the plains and the mountain valleys chiefly depends for moisture for his crops, has been appropriated and is used for the irrigation of lands contiguous thereto, whereby a comparatively small area has been reclaimed; and

Whereas there are many natural depressions near the sources and along the courses of these streams which may be converted into reservoirs for the storage of the surplus water which during the winter and spring seasons flows through the streams; from which reservoirs the water there stored can be drawn and conducted through properly constructed canals, at the proper season, thus bringing large areas of land into cultivation and making desirable much of the public land for which there is now no demand: Therefore, be it

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled: That the Secretary of the Interior, by means of the Director of the Geological Survey, be, and he is hereby, directed to make an examination of that portion of the arid regions of the United States where agriculture is carried on by means of irrigation, as to the natural advantages for the storage of water for irrigation purposes, with the practicability of constructing reservoirs, together with the capacity of the streams and the cost of construction and capacity of reservoirs, and such other facts as bear on the question of storage of water for irrigating purposes; and that he be further directed to report to Congress as soon as practicable the result of such investigations.

The sundry civil appropriation act of the same year (act of October 2, 1888, 25 Stat. L., 526), seemed to give evidence of an intention on the part of Congress to enter upon a comprehensive scheme of construction for irrigation works for, after making appropriation for the surveys of the arid regions just mentioned, it provided that "all the lands which may hereafter be designated or selected by such United States surveys for sites, for reservoirs, ditches, or canals for irrigation purposes, and all the lands made susceptible of irrigation by such reservoirs, ditches, or canals, are from this time henceforth hereby reserved from sale as the property of the United States,

and shall not be subject after the passage of this act to entry, settlement, or occupation until further provided by law."

Under this sweeping authority the Geological Survey designated as "lands made susceptible of irrigation" virtually all the lands in the arid region,[1] and these lands were accordingly withdrawn from entry. A widespread protest from persons in the arid region, adversely affected by this action, soon made itself heard and by resolution of February 14, 1889, the United States Senate authorized a select committee of seven, to be known as the Select Committee on Irrigation and Reclamation of Arid Lands, to consider the whole subject. During the months of August and September, 1889, the committee conducted meetings at a number of points in the territory affected. The majority of the committee, headed by the chairman, Senator Stewart, severely criticized Director Powell for having expended so large a portion of the funds appropriated for irrigation surveys in developing general topographic maps of the arid region, and for his general policy of withholding from settlement all lands susceptible of irrigation until such time as their disposition should be decided upon by Congress.[2]

As against the course thus pursued by Director Powell under the act of 1888, Senator Stewart proposed to place all unappropriated waters under the control of the several states and territories; the minority of the committee, however, favored the division of the arid lands into irrigation districts upon the basis of natural drainage basins, entrusting a large measure of the control over reclamation development to the people resident within each basin.

Although neither of these proposals received favorable consideration by Congress, the opposition voiced by the major-

[1] The survey upon which the action of the Geological Survey was based is frequently referred to as the Powell Irrigation Survey. The results of this survey were published in the annual reports of the Geological Survey from 1890 to 1893 inclusive.

[2] The report of the committee together with the record of the hearings held by it was printed as Senate Report No. 928, 51st Congress, 1st Session.

ity report to the existing policy of reservation found legislative expression in an act (act of August 30, 1890, 26 Stat. L., 391), by which the whole of the act of 1888 providing for the reservation of "sites for reservoirs, ditches or canals for irrigation purposes and all the lands made susceptible of irrigation by such reservoirs, ditches or canals" was revoked except as to reservoir sites, the segregation and reservation of which was expressly continued. In the following year, a further curtailment of the policy of reservation was evidenced in section 17 of the act of March 3, 1891 (26 Stat. L., 1095), which provided that reservoir sites "shall be restricted to and shall contain only so much land as is actually necessary for the construction and maintenance of reservoirs excluding so far as practicable lands occupied by actual settlers at the date of the location of said reservoirs." By the same act, moreover, as has been indicated in foregoing sections, the application of the desert land law was extended, and rights of way over the public lands were granted to irrigation companies; and in 1894 the principle of state control, urged by the majority of the Senate committee in 1889, was recognized in part, as already indicated, by the adoption of the Carey Act.

The apparent reaction in this act from the policy embodied in the acts of 1888 and 1889 was further indicated by the failure to provide any funds for the further prosecution of the investigation "of the extent to which the arid region of the United States can be redeemed by irrigation." In spite of the lack of any express appropriation, however, the duty of selecting reservoir sites for segregation still remained with the Geological Survey, as already indicated, so that, in connection with its regular work of topographic mapping, the Survey continued to devote much attention to this subject. In addition, in 1894, a specific appropriation of $12,500 was secured by the Survey "for gauging the streams and determining the water supply of the United States, including the investigations of underground currents and artesian wells in arid and semiarid sections." The appropriation for this purpose

steadily increased, amounting in the fiscal year 1903, in which the Reclamation Act went into effect, to $200,000. Since that time it has risen as high as $250,000. The data secured by the surveys and investigations made under these appropriations were, and continue to be, of primary importance to the Reclamation Service in all the exploratory phases of its work.

The period from 1894 to 1902, the year in which the Reclamation Act was adopted, was marked by a continual extension of the policy of encouraging state and individual reclamation development. In 1895 the right of way over the public lands was extended, as already indicated, to water works intended for use in mining, quarrying, and lumbering. In January of 1897, the occupation of reservoir sites was made available to the stock-raising industry, and in the next month even reservoir sites hitherto reserved by designation of the Geological Survey were thrown open to entry. In 1898 the right of way acts of 1891 and 1895 were still further extended, while in 1901 the general right of way act, to which reference has already been made, was enacted and the policy of the Carey Act was made permanent.

Though the progress of legislation during the years 1891 to 1901 thus had reference solely to the construction of reclamation works by states and by private enterprise, the advocates of reclamation by the national government had by no means been idle during this period. The hearings of the Senate committee in 1889 and the legislative and public discussion which followed their reports had served to increase and strengthen the interest in the national aspects of the subject. In 1891, there had been held a so-called National Irrigation Congress at Salt Lake City, and while this gathering had resolved in favor of the grant to the states and territories, in trust, of irrigable lands, there had been a strong sentiment in the congress in favor of a thoroughly national treatment. At a second Irrigation Congress, which was held at Los Angeles two years later, the necessity for federal con-

trol over streams flowing through more than one state was recognized, and in the following year at the third National Irrigation Congress, held at Denver, the construction and maintenance of irrigation works by the national government were expressly advocated.

At this time public interest in irrigation was further greatly stimulated by several important public documents and investigations. In connection with the work of the Senate committee, already referred to, a large amount of technical data relative to water supply conditions in the arid regions had been collected, and this material, published in 1893 under the title "Report on Irrigation, 1893,"[1] gained a considerable circulation. About the same time were published the results of the special inquiry relative to irrigation, made in connection with the eleventh census in 1890. In the agricultural enumeration for that census, the enumerators had obtained, in addition to the usual facts, statements as to the area irrigated. Circulars of inquiry were then sent to all irrigators whose names appeared in the returns, and a large amount of definite information was thus for the first time obtained concerning the cost of irrigation and the conditions existing in the irrigated areas. Still another document, which played an important part in the education of public opinion on the subject of irrigation and the relation of the national government thereto, was a report made by Captain Hiram M. Chittenden, in November, 1897.[2] This report was made pursuant to a provision of the rivers and harbors appropriation act of 1896, calling for "the examination of sites and report upon the practicability and desirability of constructing reservoirs and other hydraulic works necessary for the storage and utilization of water to prevent floods and overflows, erosion of river banks and breaks of levees, and to reinforce the flow of streams during drought and low water seasons." Although it thus had reference primarily to flood prevention works, the report de-

[1] Printed as Senate Document 41, 52d Congress, 3d Session.
[2] Printed as House Document 141, 55th Congress, 2d Session.

voted considerable attention to the value of dams and reservoirs in the arid region for purposes of irrigation. Furthermore, Captain Chittenden recommended that the government itself should build, own, and operate all reservoirs and other necessary works, holding the stored waters absolutely free for public use under local regulations.

In 1899 the movement for national construction of irrigation works was further strengthened by the formation of a permanent association to take the place of the more loosely organized annual congresses which had hitherto been held. The membership of this association numbered not only representatives of the arid region but also not a few eastern business men and representatives of national labor organizations. The active head of the association was Mr. George H. Maxwell, of San Francisco, and under his leadership the organization became very effective in disseminating information concerning irrigation and in enlisting support for the measures which it favored.

The effect of this widespread discussion of the reclamation problem was observable in 1900 in the platforms of the three leading political parties in the presidential campaign of that year, the Republican, Democratic and Silver Republican platforms all making mention of the subject. Only the last named made definite declaration in favor of national construction, declaring it to be "the duty of the general government to provide for the construction of storage reservoirs and irrigation works." The Republican platform recommended "adequate national legislation to reclaim the arid lands of the United States, reserving control of the distribution of water for irrigation to the respective states and territories"; while the Democratic platform merely declared in favor of "an intelligent system of improving the arid lands of the West."

The efforts of the advocates of national reclamation works were powerfully aided by the growing conviction in the arid and semiarid regions of the inability of state or individual enterprise to realize the full possibilities of irrigation. Even

where interstate and international complications did not interfere with effective action by the states or individuals, the expectations entertained by those who had advocated the legislation of the years 1890 to 1901, which has been traced, had failed of complete realization. Comment has already been made on the relatively meager results effected by the states under the terms of the Carey Act. On the other hand, the area reclaimed by private enterprise during the same period had been very considerable;[1] but it was appreciated that less was to be expected from private enterprise as time went on, as virtually all the opportunities for easy and inexpensive development had been taken up. Moreover, although vested rights had attached to a great part of the water and irrigable lands, yet the rate of actual utilization was far less than necessary for the proper growth of the arid country.

Experience had moreover demonstrated that irrigation works were likely to be profitable only when those constructing them owned also the lands which were to be irrigated by them, and that further private reclamation of the public lands on a large scale could, therefore, be effected only by the alienation to the developers of large compact areas of irrigable lands. The virtual impossibility of a procedure so totally at variance with the whole public land policy of the government was, however, clearly recognized; so that the irrigation problem of the public lands seemed incapable of solution by private enterprise.

Passage of the Reclamation Act. At the annual meeting of the National Irrigation Association at Chicago, November,

[1] The area reported to the Census as producing crops under irrigation more than doubled in the ten years from 1889 to 1899, the acreage rising from 3,631,381 to 7,518,527. These figures are undoubtedly large and include many lands which are watered only in part or very imperfectly. It is probable that by following a more careful definition of the term "irrigated" the acreage reported would have been greatly reduced through the exclusion of meadows watered by more or less natural means and lands which received water only following erratic storms.

1900, definite proposals for the national construction of irrigation works received extended consideration, a leading part of the discussion being taken by Representative Francis G. Newlands, of Nevada, Mr. George H. Maxwell, chairman of the executive committee, and Mr. F. H. Newell, then connected with the Geological Survey and later chief engineer and director of the Reclamation Service. Upon the opening of Congress in the following month, Mr. Newlands offered a series of bills embodying the proposals favored by the association. The essential features of these bills were as follows:

1. The government was to construct the necessary works for the reclamation of the public land and of adjacent areas which had passed into private hands.

2. The funds expended for the construction of such works were ultimately to be recovered by the government in the form of charges paid by the users of the water stored by such works.

3. The reclaimed lands were to be broken up into small holdings. The lands still owned by the government were to be alienated only to homesteaders; as to those in private ownership, a limitation of the area under a single ownership to which water would be supplied was to be imposed, and the actual residence of owners on or near their lands was to be required.

Although Mr. Newlands' bills attracted wide attention, the session of 1900-1901 closed without action by the House. But in the President's message of December, 1901, which opened the first session of the 57th Congress, the speedy enactment of comprehensive irrigation legislation was strongly urged. Mr. Roosevelt, who had succeeded to the Presidency in September, 1901, upon the death of President McKinley, had resided in the west and was well informed on the conditions obtaining in the arid regions. His message defines very comprehensively the problem and policy of reclamation by the national government. After calling attention to the need for

federal action to insure the conservation of the country's forests, he declared:

The forest alone can not, however, fully regulate and conserve the waters of the arid region. Great storage works are necessary to equalize the flow of streams and to save the flood waters. Their construction has been conclusively shown to be an undertaking too vast for private effort. Nor can it be best accomplished by the individual states acting alone. Far-reaching interstate problems are involved, and the resources of single states would often be inadequate. It is properly a national function, at least in some of its features. It is as right for the National Government to make the streams and rivers of the arid region useful by engineering works for water storage as to make useful the rivers and harbors of the humid region by engineering works of another kind. The storing of the floods in reservoirs at the headwaters of our rivers is but an enlargement of our present policy of river control, under which levees are built in the lower reaches of the same streams.

The Government should construct and maintain these reservoirs as it does other public works. Where their purpose is to regulate the flow of streams the water should be turned freely into the channels in the dry season to take the same course under the same laws as the natural flow.

The reclamation of the unsettled arid public lands presents a different problem. Here it is not enough to regulate the flow of streams. The object of the Government is to dispose of the land to settlers who will build homes upon it. To accomplish this object water must be brought within their reach.

The pioneer settlers on the arid public domain chose their homes along streams from which they could themselves divert the water to reclaim their holdings. Such opportunities are practically gone. There remain, however, vast areas of public land which can be made available for homestead settlement, but only by reservoirs and main line canals impracticable for private enterprise. These irrigation works should be built by the National Government. The lands reclaimed by them should be reserved by the Government for actual settlers, and the cost of construction should, so far as possible, be repaid by the land reclaimed. The distribution of the water, the division

of the streams among irrigators, should be left to the settlers themselves, in conformity with state laws and without interference with those laws or with vested rights. The policy of the National Government should be to aid irrigation in the several states and territories in such manner as will enable the people in the local communities to help themselves and as will stimulate needed reforms in the state laws and regulations governing irrigation.

The reclamation and settlement of the arid lands will enrich every portion of our country, just as the settlement of the Ohio and Mississippi valleys brought prosperity to the Atlantic States. The increased demand for manufactured articles will stimulate industrial production, while wider home markets and the trade of Asia will consume the larger food supplies and effectually prevent Western competition with Eastern agriculture. Indeed, the products of irrigation will be consumed chiefly in upbuilding local centers of mining and other industries, which would otherwise not come into existence at all. Our people as a whole will profit, for successful home-making is but another name for the upbuilding of the nation.

The necessary foundation has already been laid for the inauguration of the policy just described. It would be unwise to begin by doing too much, for a great deal will doubtless be learned, both as to what can and what can not be safely attempted, by the early efforts, which must of necessity be partly experimental in character. At the very beginning the Government should make clear, beyond shadow of doubt, its intention to pursue this policy on lines of the broadest public interest. No reservoir or canal should ever be built to satisfy selfish personal or local interests, but only in accordance with the advice of trained experts, after long investigation has shown the locality where all the conditions combine to make the work most needed and fraught with the greatest usefulness to the community as a whole. There should be no extravagance, and the believers in the need of irrigation will most benefit their cause by seeing to it that it is free from the least taint of excessive or reckless expenditure of the public moneys.

Whatever the nation does for the extension of irrigation should harmonize with and tend to improve the condition of those now living on irrigated land. We are not at the starting point of this development. Over two hundred millions of private capital has already been expended in the construction

of irrigation works and many millions of acres of arid land reclaimed. A high degree of enterprise and ability has been shown in the work itself, but as much can not be said in reference to the laws relating thereto. The security and value of the homes created depend largely on the stability of titles to water, but the majority of these rest on the uncertain foundation of court decisions rendered in ordinary suits at law. With a few creditable exceptions, the arid states have failed to provide for the certain and just division of streams in times of scarcity. Lax and uncertain laws have made it possible to establish rights to water in excess of actual uses or necessities, and many streams have already passed into private ownership, or a control equivalent to ownership.

Whoever controls a stream practically controls the land it renders productive, and the doctrine of private ownership of water apart from land can not prevail without causing enduring wrong. The recognition of such ownership which has been permitted to grow up in the arid regions, should give way to a more enlightened and larger recognition of the rights of the public in the control and disposal of the public water supplies. Laws founded upon conditions obtaining in humid regions, where water is too abundant to justify hoarding it, have no proper application in a dry country.

In the arid states the only right to water which should be recognized is that of use. In irrigation this right should attach to the land reclaimed and be inseparable therefrom. Granting perpetual water rights to others than users, without compensation to the public, is open to all the objections which apply to giving away perpetual franchises to the public utilities of cities. A few of the Western states have already recognized this and have incorporated in their constitutions the doctrine of perpetual state ownership of water.

The benefits which have followed the unaided development in the past justify the nation's aid and coöperation in the more difficult and important work yet to be accomplished. Laws so vitally affecting homes as those which control the water supply will only be effective when they have the sanction of the irrigators; reforms can only be final and satisfactory when they come through the enlightenment of the people most concerned. The larger development which national aid insures should, however, awaken in every arid state the determination to make its irrigation system equal in justice and effectiveness

that of any country in the civilized world. Nothing could be more unwise than for isolated communities to continue to learn everything experimentally, instead of profiting by what is known elsewhere. We are dealing with a new and momentous question, in the pregnant years while institutions are forming, and what we do will affect not only the present but future generations.

Our aim should be not simply to reclaim the largest area of land and provide homes for the largest number of people, but to create for this new industry the best possible social and industrial conditions; and this requires that we not only understand the existing situation, but avail ourselves of the best experience of the time in the solution of its problems. A careful study should be made, both by the nation and the states, of the irrigation laws and conditions here and abroad. Ultimately it will probably be necessary for the nation to coöperate with the several arid states in proportion as these states by their legislation and administration show themselves fit to receive it.

Under the stimulus of the vigorous message of President Roosevelt and of his personal interest, the principal one of the series of reclamation bills, which had been reintroduced by Mr. Newlands at the opening of the session, was passed by both houses of Congress and became law on June 17, 1902.

By the terms of the act,[1] the Secretary of the Interior was authorized to locate and construct irrigation works, including artesian wells in sixteen states and territories, embracing all of the United States west of the first tier of states west of the Mississippi, except Texas. The funds for the construction of these works were to be obtained from the sales of the public lands in those states and territories, the Secretary being directed "so far as may be practicable and subject to the existence of feasible irrigation projects to expend the major portion of the funds arising from the sale of public lands within each state and territory . . . within the limits of such state or territory." Prior to the beginning of the surveys for any contemplated irrigation works, the Secretary was authorized to withdraw from entry "any public lands

[1] The text to the act is printed in Appendix 5, p. 103.

believed to be susceptible of irrigation from said works" and thereafter such lands were to be subject to entry only under the provisions of the homestead laws, in tracts of not more than 160 acres; but the Secretary of the Interior was further authorized to limit the area of entries to such acreage as in his opinion might be "reasonably required for the support of a family upon the lands in question." The Secretary was further authorized to impose upon all lands, including those already in private ownership, which might be irrigated by the waters of the project, a proportionate part of the cost of the construction of such project, and to fix the number of annual installments, not exceeding ten, in which such charges should be paid and the time the payments should commence. All these items the Secretary was further required to announce publicly upon his determination that any irrigation project was practicable. The Secretary was further authorized to operate and maintain all reservoirs and irrigation works constructed until repayments had been made "for the major portion of the lands irrigated from the waters" of such works, whereupon the management and operation of the works, but not the reservoirs, was to pass to the owners of the irrigated lands, to be maintained at their expense under the supervision of the Secretary. Entrymen upon lands to be irrigated were required to reclaim at least one-half of the total irrigable area of their entries for agricultural purposes. With reference to land in private ownership, it was provided that no right to the use of water for such land was to be sold for a tract exceeding 160 acres to any one land owner, nor unless such land owner was an actual bona-fide resident or occupant of such land.

Novel as were the substantive policy and the method of financing provided by the act, the wide discretion vested in the Secretary of the Interior in the determination of the methods to be used in carrying out the intent of the act was equally novel. Not only was he entrusted with complete and sole responsibility for locating and passing upon the practicability

of projects, but with reference to the actual construction it was provided merely that "eight hours shall constitute a day's work" and that "no Mongolian labor shall be employed," all matters of organization and procedure being left entirely to the Secretary. He was, moreover, authorized to acquire, by purchase or by condemnation, "any rights or property" necessary for carrying out the act.

Origin and Development of the Reclamation Service. Within a few weeks after the passage of the Reclamation Act, the Secretary of the Interior, Ethan Allen Hitchcock, upon the recommendation of the Director of the Geological Survey, Charles D. Walcott, ordered the creation of an organization to be known as the Reclamation Service, to be under the jurisdiction of the Director of the Geological Survey but not to be a part of the Survey.

In the preceding section account was given of the appropriation by Congress, in 1888 and 1889, of $350,000 for surveys of the arid regions by the Geological Survey, and the appropriations to that service, beginning in 1894 and increasing yearly, for gauging streams and determining the water supply of the United States. In the expenditure of the funds thus appropriated there had been created in the Geological Survey a Division of Hydrography. The staff of this division, composed of men familiar from long experience with the conditions of the arid regions, was now used as the nucleus for the new Reclamation Service. The chief of the division, Frederick Haynes Newell, whose activities in connection with the enactment of the Reclamation Act have already been referred to, was appointed head of the Service, with the title of Chief Engineer, and his assistants also were largely drawn from the hydrographic division.

For about five years after its establishment, the Reclamation Service remained under the direction of the Director of the Geological Survey. On March 9, 1907, it became an independent service, subject to control only by the Secretary

of the Interior. The action by the Secretary effecting this change was based upon recommendations made by the Director of the Geological Survey, who gave it as his view that "the principal need at the present time is that of establishing a somewhat more direct personal contact between the Director of the Reclamation Service and the Secretary of the Interior and the cutting out of intermediate steps which are believed, through the experience of several years, to be unnecessary and to serve rather to delay than to expedite public business."

F. H. Newell, Chief Engineer of the Service, was appointed Director of the new independent service. Mr. Newell's place as Chief Engineer was filled by the promotion of Arthur Powell Davis, Assistant Chief Engineer.

On December 13, 1913, by an order of the Secretary of the Interior, the Director of the Service was relieved of responsibility for the general administrative oversight of the Service and for making recommendations upon questions of policy to the Secretary, these functions being vested in a body to be known as the Reclamation Commission. This body was ordered to be composed of the Director of the Service (as chairman), the Chief Engineer, the Chief Counsel, the Comptroller, and the Supervisor of Irrigation. Within the division of the administration entrusted to him, each member of the Commission was responsible only to the Secretary of the Interior. In December, 1914, the Chief of Construction was made a member of the Commission.

After about a year and a half of operation under this system the Secretary of the Interior, on May 6, 1915, reduced the membership of the Commission to three, the positions of Director and Chief Engineer being consolidated and the Supervisor of Irrigation and the Chief of Construction being dropped from the Commission.

The volume of work carried on by the Service during its fifteen years of existence has varied widely. Most of the first year was spent in organization and planning work. On March 14, 1903, however, less than one year after the passage

of the act, six major projects were approved, and a few months later, on August 28, 1903, construction was begun on the first of these, the Truckee-Carson Project in Nevada. In 1904, five additional projects were authorized; in 1905, nine; in 1906, four, and in 1907, one. Since that time but one major

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project has been authorized, and three minor projects located on Indian reservations have been undertaken. In addition, no less than fifty-three additional reclamation schemes have been examined and preliminary surveys made. These are known as "secondary projects," and will form the basis for any future construction work which may be undertaken by the Service.

To date the Service has initiated and brought to various stages of completion, twenty-six separate projects. Of these fifteen have been practically completed in all their units, ten have been partially completed, and one is still in the first stage of construction. The work to date has involved the construction of one hundred large storage and diversion dams, about eleven thousand miles of canals and distributaries, and some thousands of minor and auxiliary structures.

The cost of the work thus far completed is nearly $125,000,000. The total area irrigable by these works is about 3,000,000 acres. To date slightly less than half of this acreage has been provided with water, while less than a third is under cultivation. The value of the crops produced on these lands in 1917 is estimated at $52,000,000.

Development of Reclamation Policy, 1902 to Date. The basic policy enacted by the Reclamation Act of 1902 has persisted without change up to the present time. In several respects, however, the provisions of the original act have been modified. In what follows only the most important of these changes are noted.

Very early in the application of the act, it became evident that a more comprehensive policy must be adopted than had been formulated in the act, relative to the inclusion of privately owned lands in reclamation projects. In the framing of the act, provision had been made for the imposition of a proportionate part of the cost of the construction of projects upon the private lands which might seek the use of the water furnished by such projects. It had not, however, been thought necessary to provide for any form of security for the payment of such charges, as was provided in the case of the public lands in the project, for it was assumed that the private lands in a project would in no case bear any large proportion to the public lands. It was pointed out that there were upwards of 400,000,000 acres of arid land belonging to the

United States and that there was a water supply adequate for 40,000,000 acres.

In point of fact, however, individuals and corporations had been very active in the selection of and acquisition of title to tracts located along or adjacent to the streams, so that there were few large compact bodies of irrigable land which were not cut into by private ownership or within which entrymen had not already taken up the choice spots. When, therefore, the task devolved upon the engineers of the Reclamation Service of selecting the areas to be irrigated, they were able to find few locations in which it was possible economically to irrigate large bodies of public land without at the same time irrigating considerable tracts in private ownership.

Thus, on the Truckee-Carson Project in Nevada, where the first construction was undertaken, the lands chosen for reclamation were in the desert beyond the bounds of the Central Pacific Railroad land grant and so remote and apparently worthless that individuals had not entered upon them to any great extent. Yet even here, the best lands were privately owned.

Moreover, in some of the cases where the limitation of the benefits of the project to public lands was practicable, it would have necessitated the absorption into the project of water courses which were already in either actual or prospective use by settlers in the vicinity. Thus, in the Salt River Valley of Arizona there were great tracts of vacant public lands which might be reclaimed, but their reclamation would directly or indirectly have forced a large part of the resident population to abandon their partly cultivated lands. Because of this condition, Secretary of the Interior Hitchcock, acting under instructions from President Roosevelt, finally concluded to permit the stored water to be devoted to the privately owned lands instead of using it for irrigating adjacent tracts of public land.

So large was the proportion of the irrigable area in private ownership found to be, that it was considered indispensable

that proper security be obtained for the payment of construction charges by such settlers as should desire the inclusion of their lands in the project. Under the conditions such security would naturally take the form of a mortgage on the lands. On even the smaller projects, however, the number of settlers already holding lands which could profitably be drawn into the project might number several hundreds; in the larger projects, as in the case of the Salt River Valley in Arizona, several thousands were involved, many of them non-resident.

The difficulty, if not the impracticability or even impossibility of dealing with each of these widely scattered owners was obvious; and the Reclamation Service therefore developed, in coöperation with citizens' organizations in the arid regions, an expedient which finds no express warrant in the law—the organization of the landholders within the boundaries of a project into a so-called water users' association, which should give to the government a collective mortgage on the private lands to be benefited by the project as security for the payment of the construction charges assessed against those lands.

The development of the principle of water users' associations has made possible the application of the Reclamation Act to large areas which must otherwise have been denied its benefits. Of the twenty-six projects initiated to date by the Service, no less than twenty-three have required the formation of a water users' association.

In 1905 the scope of the Reclamation Act was extended to a portion of the state of Texas to permit the construction of a project in New Mexico on the Rio Grande. In the following year, the provisions of the act were extended to the whole of the state of Texas. In 1908, following the passage of a number of special acts for the reclamation of the lands allotted to various Indian tribes, a general act was passed authorizing the Secretary of the Interior to enter into any arrangement or agreement with Indian tribes for the reclamation of lands allotted to them under the general allotment act.

At the time of the passage of the Reclamation Act it was assumed that if the government built the reservoirs and the main line canals, the land owners, following the precedents of the pioneer, would build the remaining minor works. This was found to be impracticable unless the government supervised operations and furnished the necessary supplies and a part at least of the machinery and capital. To meet this situation, a novel fiscal expedient was devised. Agreements were entered into with the water users' associations on the several projects for the performance by their members of portions of the construction work, the association receiving in return the right to issue to its members so-called "coöperative certificates," to the amount of the work done. The manner in which these certificates were made available for the payment of land and construction charges may be seen from the following official explanation:

Section 4 of the reclamation act states that the charges made against any farm unit shall be estimated with a view of returning to the reclamation fund the estimated cost of construction of the works and shall be apportioned equitably. This equitable apportionment can be secured if the holder of the farm unit presents to the Secretary certain rights of property, which is a desirable part of the system. By accepting this right of interest the Secretary is enabled to reduce equitably the charges against a particular parcel of land.

This exchange of values or equitable apportionment is entirely independent of the collection of cash charges. These by law are placed in the hands of the Land Office. The transaction as regards equitable exchange must be completed in such a way that the Land Office is called upon to take cognizance only of the cash payment, and not of the details of the reduction of charge due to this equitable apportionment.

All matters of acquiring rights or property as part of the construction of the complete irrigation system are made by the officers of the Reclamation Service, and are completed in such a manner or at such times as will enable the Land Office to consider the cash payments as a separate transaction.[1]

[1] Reclamation Service: Coöperative Certificates, Issue and Use by Associations of Settlers and Water Users (1908), p. 6.

It should be noted that the coöperative certificates were not currency nor were they evidence of liability on the part of the government. By their use there was made possible a quick "turn over" or exchange of values without the necessity of cash payments from the Treasury, followed by the collection of an equivalent amount from the settlers.

The plan for the issue of coöperative certificates was approved by the Secretary of the Interior, James R. Garfield, on February 21, 1908, and was put into effect directly thereafter. They were quite widely and successfully used until 1910, when their issue was stopped in accordance with a decision of the Attorney General that the procedure was without explicit warrant of law.

In place of these coöperative certificates or equivalent bookkeeping methods of transfer of credit, it was considered advisable by Congress to make available a larger amount of money than was in sight in the Reclamation Service fund. The original act limited the funds to the proceeds from the disposal of public lands and there was some impatience with the rate of progress imposed by such limitation. Accordingly, by act of June 25, 1910, the Secretary of the Treasury was authorized to transfer to the credit of the reclamation fund such sums not exceeding $20,000,000 as were deemed necessary to complete the projects or to protect the water rights, with the proviso that all sums so transferred should be reimbursed to the Treasury from the reclamation fund, beginning five years after date of the first transfer and at the rate of 50 per cent. of the annual receipts to the reclamation fund. As a matter of fact, it was found that there was not as great a necessity for utilizing this money as had been anticipated by its advocates because, under existing conditions of settlement and of labor, it was not practicable to push construction at a rate greatly exceeding the regular income of the reclamation fund. A certain length of time was necessary for the utilization of the works already built. Hence, it was not

until over four years later that the first advances were made on account of the $20,000,000.

In 1906 the sale of surplus power developed on any project had been authorized and in 1911 this policy was extended to permit the sale of surplus water to private or state reclamation works. Restrictions were, however, imposed to assure the beneficial use of such water by the projects buying it.

Important changes in the fiscal policy relative to reclamation works were effected by the so-called Reclamation Extension Act of August, 1914. To meet the difficulty experienced by many of the settlers on the projects in meeting the requirement of the law, that construction charges be repaid within ten years, the act granted twenty years for the payment of all charges still unpaid, and provided that on all entries thereafter made twenty years should be allowed for repayment, no charges whatever, other than the initial charge, being required during the first five years.

By the same act, definite authority was conferred upon the Secretary of the Interior to impose charges for operation and maintenance—an authority long exercised without express legislative warrant.

On the other hand, the Reclamation Extension Act of 1914 imposed a serious limitation on the power which had theretofore been vested in the Secretary of the Interior in the selection of new projects or units for construction. By the original Reclamation Act, as has been stated, the power of selection had been vested solely in the Secretary, subject only to the fiscal limitations of the reclamation fund. By the act of June 25, 1910, which, as already seen, provided for advances to the reclamation fund for the completion of projects already begun, it had been further provided that new projects should be begun only on the direct order of the President. By the Reclamation Extension Act of 1914, it was now provided that the Secretary of the Interior should submit to Congress, in his estimates for the next fiscal year, detailed estimates of the cost of the extension and completion of exist-

ing projects and units thereof, and of the construction of new projects; and it was expressly provided that after July 1, 1915, no expenditure should be made out of the reclamation fund except in pursuance of appropriations made by Congress. In the sundry civil appropriation act of March 3, 1915 (38 Stat., 859), this policy was accordingly put into effect, definite appropriations being made for each of the projects then being carried forward by the Service. The same method has been followed for the fiscal years 1917 and 1918. In none of these three acts has appropriation been made for any new project, unless the proposed Lawton, Oklahoma, work be thus considered.

In one other important respect the act of 1914 tended toward the limitation of the operations of the Service. The Reclamation Act had provided that when the construction charges applicable to the major portion of the lands on a project had been repaid to the reclamation fund, the Secretary of the Interior might turn the management of the irrigation works over to the owners of the lands irrigated, but that the management and operation of the reservoirs and the works necessary for their protection should remain in the government. By the Reclamation Extension Act, however, the Secretary was authorized to turn over to local control "the care, operation and maintenance of all or any part of the project works."

CHAPTER II

ACTIVITIES

The manifold operations of the Reclamation Service may not properly be regarded as distinct and separate lines of activity. They are merely parts of a single activity—the reclamation of arid lands in the west by means of irrigation works. In what follows, therefore, the characteristics of the several types of reclamation projects—the physical conditions encountered and the nature of the works required to overcome them—are first outlined under the head "Characteristics of Projects." Account is then given of the specific activities involved in the initiation, construction, and management of the projects.

Characteristics of Projects. The primary works embraced in an irrigation project may be regarded as being made up of two parts—those works, such as dams, canals and tunnels, required to bring the water to a suitable point on the area to be irrigated; and those, consisting chiefly of ditches, required to carry it from that point to the several farms and tracts in the area. Beyond this there lie, of course, the small channels on each farm, which distribute the water over its surface for its final absorption by the soil. These last works are, however, not properly regarded as part of the project proper, being the concern chiefly of the individual whose land they supply and are not in practice constructed by the Service.

The works required for bringing the water to the irrigable area constitute, it is needless to state, far the major problem of the Service. The primary physical factor determining the nature of such works is the adequacy of the available natural water supply for the requirements of the area. If the sup-

plies naturally present in the water courses and lakes be adequate to the requirements of the lands at all seasons, there will be needed merely suitable diversion works designed to bring these waters from their natural courses or beds to the area to be irrigated. More generally, however, in the arid regions the natural flow of the water courses during the farming season is extremely meager or is too irregular to permit reliance being placed upon it. There is thus necessitated for the utilization of these waters the construction of works for the storage of the excess and unseasonable flow for use during the times of drought and need.

Diversion Works. Examples of projects with a practically unlimited supply, requiring only diversion works for their utilization, are those along the larger rivers, as the Yuma Project in southern Arizona and adjacent portions of California, watered by the Colorado River of the West; the North Dakota Pumping Project, which draws upon the Missouri River, and the Huntley and Lower Yellowstone Projects in Montana, supplied by the Yellowstone River. The Klamath Project in Oregon is essentially in the same category as these river projects, except that its supply is drawn from a large natural lake before the escape of the water to the Klamath River into which the lake naturally discharges.

In some cases the natural elevation of the waters is such as to make possible their diversion to the lands to be irrigated by the construction merely of suitable canals or tunnels. Thus, among the river projects above mentioned, the supply of the Huntley Project is drawn off by means of a tunnel whose floor is below the low-water surface of the river; and a similar solution was achieved in the Klamath Project, just mentioned. In most cases, however, even though the natural supply be sufficient in quantity, its elevation above the valley lands to which it is desired to bring the water is insufficient, so that it becomes necessary to raise the water and thus give it sufficient head to flow out into the canals built along the valley.

This is the situation in the case of all the river projects above named, except the Huntley Project.

In the case of all of the projects but one, the raising of the water is effected by means of a dam. Because of the large and irregular flow of the rivers supplying these projects, these "diversion dams," as they are called, must be built to withstand great floods and at all times to safely pass over the crest large volumes of water. A large and expensive overflow dam or weir in the main stream is, therefore, the most striking feature of each of these projects.

In the case of the North Dakota Pumping Project, however, the elevation and fall of the Missouri River were not adequate to permit raising the water by a diversion dam, and the installation of a pumping plant was, therefore, resorted to. To supply the power plant the Service mines its own coal at Williston, owning and operating the mine.

Projects deriving their water from adequate natural supplies and requiring only diversion works for their utilization are in the same class as most of those built in earlier days by individual and corporate efforts. Indeed, even before the passage of the Reclamation Act, private enterprise had already seized upon most opportunities of this kind. It is to be expected, therefore, that in the future there will be relatively still fewer projects of the type built. In connection with some of the direct diversion projects already constructed moreover, although the natural supplies are now adequate at all seasons to the demands made upon them, the fuller development or extension of the irrigable area supplied may make necessary the construction of storage works. Those reclamation projects which depend for water upon the storage of floods or of winter flow may, therefore, be considered as the more typical projects of the arid region, and they are steadily increasing in importance both as to number and size.

Storage Works. The size and character of the dams required to effect the storage of an adequate supply of water

vary widely from project to project, depending upon the nature of the reservoir sites available.

In a few cases a storage reservoir already exists in the shape of a lake located at the headwater of a river. Here it has been possible to increase the storage capacity of the lake basin by means of relatively small and inexpensive dams. The most striking case is that of Lake Tahoe on the Truckee-Carson Project, where a low dam built across the narrow outlet of the lake greatly increased the storage capacity. Comparable conditions are found on the Yakima Project in Washington. On the Minidoka Project in southern Idaho, on the other hand, the increase of the storage capacity of Jackson Lake had to be supplemented by the creation of an artificial lake, known as Lake Walcott, at the head of the main canal.

The more usual conditions, however, are those where artificial bodies of water are created in depressions or valleys which in the natural state contained little and in some cases no water. The greater number of projects built by the government are of this character.

Where the valley or depression whose outlet is to be closed is the bed of a stream, special difficulties are usually met with respect to the foundation of the dam. Throughout the arid region the streams have, as a rule, filled up their beds above the old bed rock with accumulated débris from 50 to 100 feet or more in depth. Under these conditions masonry structures are very expensive if not impracticable, and earthen dams must generally be resorted to. The development of a type of earthen dam which, while economical to construct, will be water-tight and can carry maximum floods in its spillways has thus been one of the key problems of the Service.

Instances of earthen dams are found in the Boise Project in southern Idaho, where the rim of a broad depression has been completed by building several long, low earthen dams; the Truckee-Carson Project where storage of a supplementary supply on Carson River is effected by an earthen dam provided

with a large concrete spillway over which excessive floods may pass, and the Umatilla Project in Oregon where the flood flow from the river of that name is stored by a large earthen dam built out on what was formerly a dry desert. Perhaps the most notable of the earthen dams is that on the Belle Fourche Project in South Dakota comparable in height and length with the Gatun dam at Panama, though much thinner in cross section.

Where, however, solid rock is found at reasonable depth beneath the surface, it is possible to build dams of apparently greater stability and of more imposing character. Chief among these is the Roosevelt dam in Arizona controlling water for the Salt River Project. The magnitude and picturesque location of this structure built of masonry appeal to the imagination and cause it to be popularly regarded as typifying the enterprises of the Reclamation Service. It was made possible not only by the solid rock found beneath the river channel, but by the excellent material for building found in adjacent cliffs. Similar conditions existed on the North Platte River in central Wyoming where, at what is known as the Pathfinder site, the stream had cut through granite walls, permitting large masses of masonry to be economically quarried, and a high wall to be built in the narrow canyon.

It more often happens, however, that the rock available for construction of a dam is of inferior quality, and with modern methods and machinery it can be more economically crushed to small size, mixed with sand and cement, and then poured into place to form a monolithic structure. This condition makes possible the organization of a steady working force and a routine comparable to that of a manufacturing establishment, in which the raw materials are prepared, mixed, and put into place systematically during three 8-hour shifts every day and for weeks, months, or years in succession with hardly a break. There results a higher economy than is possible under the less systematic methods of quarrying and delivering large stones of irregular shape and strength.

The concrete dam is, therefore, next to the earthen dam, the structure which is of most importance in present and future development. It is well typified by the East Park dam on the Orland Project in California, which is built on the arch plan so that the water behind it forces it more firmly against the side walls. Larger and more striking, however, is the Arrowrock dam on the Boise River, the highest in the world, the crest being 350 feet above bedrock. It is built of rubble concrete and on the arch plan. Comparable with this in size and importance is the Elephant Butte dam across the Rio Grande in New Mexico, about 150 miles north of the Mexican border. It is likewise built of rubble concrete but in a straight line.

The forms of diversion works employed in conveying stored water from the reservoir to the lands to be irrigated do not differ in essentials from those employed for diverting natural supplies. Both tunnel and canal structures are employed. Such canals or tunnels in some cases begin directly at the reservoir, in others use is made, for a greater or less distance, of the bed of the stream across which the dam is constructed. A striking example of such use is found in the case of the Salt River Project in Arizona where the water stored by the Roosevelt dam is permitted, as needed, to flow through the impassable and almost unknown canyons for forty miles, emerging at the edge of the desert valley where the task of diversion is taken up by artificial works.

Distributing Systems. The works for storing or diverting water are usually built of such mass and material as to be almost indestructible and the cost of maintenance is relatively insignificant. The distributing system which takes the water to each and every irrigated farm and field requires, especially during the irrigation season, continual manipulation and oversight and frequent cleaning and repairs.

The character of the distributing system is dictated by the topography or slope of the fields. If the irrigable area is a

plain with gentle slope, it may be possible to lay out a system and build the hundreds of miles of smaller canals and ditches with great economy on straight lines and later maintain these with the minimum of labor. If, however, as on the Umatilla Project in Oregon, the ground is rolling, the distributing canals must be built to follow as far as possible the leading ridges and cross from one high point to another either by flumes elevated in the air or by pipes buried beneath the surface. Thus canals and ditches cross and recross each other at different levels and the system of distribution is not only very expensive to build but difficult to maintain.

Drainage Systems. In all irrigation projects drainage is as essential as is a sewage system in a city having an abundant water supply and for the same reason, namely, the necessity of disposing of waste or surplus water. The need for drainage is not always immediately apparent, but in course of time the country becomes saturated and unless drainage is resorted to the excess water not only appears on the surface of the low grounds but brings up the alkaline salt, forming a crust on the surface and destroying nearly all useful vegetation.

The natural drainage of the several projects varies greatly, the need for the construction of drainage works varying correspondingly. Illustrative of projects having excellent natural drainage is the North Platte Project in Nebraska and Wyoming where the lands lie in a long narrow strip in the valley bordering the natural channel and are watered by a single main canal which roughly parallels the river. From this main line canal smaller laterals take out water each in successive order and the excess or seepage escapes to the river channel.

In contrast to this are the conditions where the irrigable area is out on a broad plain and consists of a compact group of farms lying in a broad belt running away from the stream. Here the seepage water does not have a quick or immediate outlet toward the main stream. Such, for example, is the

Minidoka Project in Idaho, or the Salt River Project in Arizona. Under these conditions the question of drainage becomes particularly difficult and important.

For most of the reclamation projects, drainage systems have been outlined and in part constructed. Where the lands are nearly level, as on the north side of Snake River on the Minidoka Project, Idaho, large expenditures are necessitated. This area, originally a dry sandy plain, has been so generously supplied with water that it has accumulated in every depression and valuable fields have been injured. Deep drains have been provided and arrangements made to pump out some of the excess water from the depressions to which it can be led by gravity flow. Similar conditions exist on the older part of the Boise Project in Idaho and on the Rio Grande Project in New Mexico and Texas.

Anomalous drainage conditions are found on the Shoshone Project in Wyoming. Although the slope of the land is quite noticeable, being nearly 20 feet to the mile, and the surface soil is underlaid with thick beds of gravel, the water has not passed out through the gravels, much to the surprise of agricultural experts. Swampy areas have been formed even on the slopes and to relieve these a drainage system has been laid out in accordance not with the surface but the subsurface conditions, which are responsible for the peculiar situation described.

The leading characteristics of the various types of reclamation projects having been described, account will now be given of the specific activities involved in the initiation, construction, and management of those projects, grouped under heads corresponding in the main to the several stages commonly followed in the realization of a particular project. These are:

1. Location of project.
2. Designing of project.
3. Construction of project.

4. Opening of project.
5. Fiscal management of project.
6. Operation of works.
7. Transfer to water users' association.
8. Dissemination of information to water users.

Location of Projects. As has been pointed out in the preceding chapter, the Secretary of the Interior was, by the original terms of the Reclamation Act, authorized to locate the works constructed under the act. The location by Secretary of the Interior Hitchcock of the twenty-five projects authorized between 1902 and 1907 was, in fact, determined by him with the concurrence of President Roosevelt.

In 1910, as already stated, the direct order of the President was made necessary for the location of any new project, and in 1915 Congress in effect reserved to itself the right to locate projects in future by adopting the policy of making annual appropriations for specific projects.

Since the adoption of this policy, however, Congress has authorized the construction of no new projects. It is consequently not practicable to give any accurate account of the procedure which would now be followed by the Service in locating a new project, in pursuance or in expectation of an authorization by Congress. Instead there can be given only a statement of the procedure which was followed by the Service in the years prior to the enactment requiring congressional authorization.

The first step in that procedure was the selection of a particular area as probably susceptible of irrigation. The public lands in this area were thereupon withdrawn from entry. Detailed examination of the area for determination of the practicability of its reclamation was then made and recommendation forwarded to the Secretary of the Interior accordingly. Upon favorable consideration of the recommendation by the Secretary, authority to proceed with the design and construction of the works was issued by him.

The selection of irrigable areas depends not only upon considerations relating to the adequacy of the water supply, the feasibility of storing and conducting it, and to the suitability of the soil for agriculture, but also upon certain legal or artificial conditions of title to land and water, state lines, and other factors.

The climate in nearly every part of the arid region, except on the higher mountains, is suitable for the production of some kind of valuable crop; the soil, although differing in value in each locality, is of such quality throughout the arid region that with care and skill it can usually be rendered sufficiently productive to justify cultivation by irrigation. Thus, climate and soil are given consideration, but they are so generally found to be good or fair that few, if any, projects are rejected or seriously modified on account of them.

Market conditions or distance from centers of population constitute an important consideration in the selection and growth of a project. Each large irrigation enterprise projected at a remote point has been connected with the outside world by railroad routes so that if there is discovered a large body of land susceptible of irrigation, there has been usually little delay in entering upon the construction on the ground that it is remote from markets. Experience has shown that by the time crops were produced some one railroad or more often two competing roads have been built crossing the reclaimed lands.

The more vital points considered in the selection of the project and in the planning of works are the limitations which grow out of the quantity or location of water supply. Data regarding water supply, upon which was based the initial selection of irrigable areas by the Reclamation Service in the several years following the passage of the Reclamation Act, had already been collected in large measure by the Geological Survey, partly in connection with the so-called Powell Survey carried on under the appropriations of 1888 and 1889, partly under the regular water resources appropriations and, in large

measure, as a part of the regular topographic and geologic mapping of the country. In addition, there was available a considerable amount of data which had been obtained by corporations or individuals as preliminary to the possible construction of private irrigation works, as well as by state engineers in connection with the construction of irrigation works under the Carey Act. In Nevada and western California a number of surveys had been made by Representative, later Senator Francis G. Newlands, of Nevada, whose activity in securing the enactment of the Reclamation Act has already been referred to.

The work of topographic mapping and of investigation of water resources is still being carried on by the Geological Survey for the arid regions, as for the other sections of the country, and the results of these investigations will doubtless be made use of by the Reclamation Service in the preliminary selection of additional irrigable areas, should it be decided to enter upon the construction of new projects.

In the initial selection of irrigable areas the choice of projects was governed less by the question of ease or cheapness of work than by the expressed desire on the part of public men that the Reclamation Service should confine its efforts as largely as possible to those works which for one cause or another could not readily be built by corporate effort, namely, those involving interstate or international relations or legal complications which put them beyond the reach of either private or state enterprise. Lands which might be reclaimed were being held out of use by the fact that their reclamation depended upon coöperation between states or upon use of interstate streams. For example, the lands now embraced in the North Platte Project in Nebraska could be irrigated only by water stored in Wyoming, much of which originates in Colorado; but the officials of the latter state claimed the right to hold or divert all water which occurs in that state even though under natural conditions it flows across the boundaries and is needed elsewhere. Similarly, the project on the lower

Rio Grande was made possible only by a treaty with Mexico, and the St. Mary-Milk River canal was built following the successful negotiation of a treaty with Great Britain on behalf of the Canadian interests.

Reference has already been made, in the preceding chapter, to the attempt made, in the first selection of projects, to give preference to those consisting mainly of public lands and of the reasons for its abandonment.

The conclusion having been reached by the Reclamation Service that a given area offered a possible location for a reclamation project, recommendation was made to the Secretary of the Interior that the public lands in that area be withdrawn from entry under the public land laws.

Up to the time that the lands are actually withdrawn the work must necessarily be somewhat confidential in character in order to prevent enterprising individuals from seizing upon pieces of land which might be needed in the development of the system. Many a desirable irrigation project has been blocked or heavily burdened by speculators obtaining possession of land necessary for the prosecution of work. When, however, the lands have been withdrawn and there is no longer necessity for secrecy, the plans may be disclosed and submitted to searching scrutiny.

Withdrawal of Lands. The withdrawal of the public lands in the irrigable area from entry is effected through the General Land Office. The lands withdrawn are designated as having been withdrawn under either the "first form" or the "second form." Lands withdrawn under the "first form" are withdrawn absolutely, on the ground of their being required for the irrigation works and subsidiary structures. Those withdrawn under the "second form" are so withdrawn because they are, to quote the act, "believed to be susceptible of irrigation from said works." They are withdrawn only from all forms of entry other than that provided by the homestead laws, as modified by the Reclamation Act.

Withdrawal, whether under the first or second form, af-

fects only tracts, the ownership or control of which has not already passed out of the hands of the officers of the General Land Office. Claims already initiated are not affected. In the case of relinquishment or abandonment of any of these rights, however, the withdrawal automatically takes effect.

When it is definitely established by the engineers of the Reclamation Service that any of the lands withdrawn will not be required for construction, operation or maintenance, or that they cannot be irrigated under the project, such lands are restored to public entry.

Preliminary survey of the lands withdrawn is next made. In this examination careful attention is given not merely to the topographic and hydrographic features of the area, but to the climatic conditions (especially the temperature and rainfall, frosts, and the character of the soil), to the factors affecting transportation, and to vested rights in and claims to lands and the use of waters.

The detailed data regarding available water supply are obtained almost wholly from the United States Geological Survey, one of the functions of that service being, as already stated, that of investigating the water resources of the United States, including the measurement of stream flow. The facts gathered by it are used by the Reclamation Service in determining whether the water within a drainage area was sufficient for the successful cultivation of the lands to be included within an irrigation project.

Formation of Water Users' Associations. In the initial selection of projects, the examination of the situation existing with respect to the ownership of the irrigable area revealed, in many cases, the necessity of obtaining for the government a mortgage upon the lands in private ownership as security for the repayment of the construction charges. This was accomplished, as explained in the preceding chapter, by the formation of water users' associations.

Although the form of agreement adopted by the twenty-two water users' associations in different parts of the country

varied in accordance with local needs, in virtually every case each person joining such organizations agreed

(1) to turn over to the management of the association all water which he had heretofore appropriated, to be administered in connection with the additional water supply furnished from the government irrigation system;

(2) to make his former water rights, as well as the government water rights, appurtenant to the land irrigated;

(3) to pay the construction charges which might be imposed by the Secretary of the Interior pursuant to the Reclamation Act;

(4) that such charges should be a lien on the land, which the association might enforce;

(5) to dispose of the lands he owned in excess of 160 acres, that being the maximum area under single ownership to which water might be supplied under the Reclamation Act. In some cases 80 acres was set as the maximum.

The form of organization which has hitherto been adopted for water users' organizations is that of a corporation, each member holding stock therein in proportion to the acreage of irrigable land owned by him.

Authorization of Project. Upon the completion of the preliminary survey and, where necessary, of negotiations with the water users' association, recommendation was made, where warranted, to the Secretary of the Interior that the project be declared practicable. Of the seventy-nine irrigable areas which were examined by the Service during the years 1902-1907, only twenty-five were recommended to the Secretary as then practicable for irrigation. The remainder have been designated "secondary projects" and some of them will doubtless form the basis for future operations of the Service, should the initiation of new projects be decided on by Congress.

Upon approval by the Secretary of the recommendation of a project as practicable, authorization was issued to the Director of the Service to proceed with the preparation of the plans and with the construction of so much of the works as seemed warranted by the condition of the reclamation fund.

Of the twenty-six primary projects constructed by the Service, all but one were authorized during the administration of President Roosevelt, and the Secretary of the Interior in every case conferred with him prior to issuing authorization.

Designing the Project Works. The Service has not, for several years past, been called upon to design any new projects, but it has been necessary from time to time to design new units or extensions of existing projects. The preparation of plans and specifications may, therefore, be regarded as one of the current activities of the Service.

Selection of Reservoir Sites. On the typical project, the selection of a reservoir site is commonly the controlling feature of the design and to it attention must first be given. Within each upland or mountainous area from which water might be had there are commonly a number of possible reservoir sites. The preliminary reconnaissance usually reveals these, but not even the most experienced engineer can readily decide which is preferable. The relative value of the several alternatives presented can be determined only by obtaining data concerning the capacity of the reservoirs and their location with reference to the available supply. For example, the best reservoir site may be so high in the mountains that it cannot receive sufficient water, while a smaller and more expensive site may be found lower down but so limited in capacity as not to hold all of the available supply. A large reservoir may have an expensive dam site or a basin of small capacity may possess an excellent dam site. There are almost innumerable conditions which must be taken into account, and to give proper weight to each of these it is necessary that there be made surveys of sufficient detail to show the capacity of the various sites, the ability to fill them, and the character of the dam sites and other necessary adjuncts.

After a general study of various possibilities has been finished, selection is made of the one or two reservoir sites

which appear to be most favorable. It is then necessary to make more detailed examinations to verify the assumptions made, and to ascertain with great exactness not only the contents of the reservoir for various heights of water but, more than this, the exact size and shape of the site upon which it is proposed to build a dam. There is usually quite a range of practicable locations as, for example, the dam may be placed a few hundred yards higher up stream with possibly greater length or lower down on a better foundation, the larger cubical contents of the dam in one locality balancing certain advantages of depth to foundation or material available at another spot.

The detailed surveys at the various proposed dam sites are usually made on a scale of 100 feet to the inch, more or less, and with contour interval of from two to five feet, dependent upon the steepness of the sides. Explorations of the underground conditions are also made either by open pits or shafts, or by deep holes put down with a diamond drill which recovers the core, or by some of the ordinary forms of well drill. A study of the records of these drillings furnishes facts usually sufficient to reveal the relative advantages and disadvantages of the alternative locations and enables a selection to be made from among them.

Preparation of Detailed Topographic and Land Map. Before laying out the distributing system, it is necessary that there be available a detailed map, not only of the topography but of the boundaries of the several tracts of public and private land within the irrigable area, as well as of township, quarter-section, and meander lines.

A topographic map is prepared of the grounds about the headworks of each important main canal and is continued in a narrow belt along the line of the proposed canal and out to the irrigable lands. This drawing is made in sufficient detail to permit the "paper location" of the works by study in the local office; in other words, instead of the actual survey and location on the ground of each of the several alter-

nate lines, the map is so prepared as to permit exact comparison of the various suggested lines and grades. For example, it may seem that a main canal with rapid fall and narrow cross-section can be built more economically than a canal with less slope and a wider section. To ascertain whether this is actually the case a paper location is made, and this may be followed, if the map is sufficiently accurate, by a computation of quantities, all being done at far less cost than by separate surveys in the field.

In addition to the detailed maps of the main canal lines, a topographic map is prepared of all the irrigable lands to which the distribution system is to be built. This map is made on a scale of from 400 to 1000 feet to the inch, with contour intervals at vertical distances of from five to ten feet. On it is indicated, also, the character of soil, studies of which have in the meantime been made by the experts of the Department of Agriculture, and other important features. By means of this map it is possible to locate the branches of the proposed distribution system.

On the broad undulating surface of the irrigable lands there are frequently available numerous alternatives for the location of the canal system. Sometimes there is found a series of leading ridges which limit the method of laying out the distribution system, but, in other cases, there is a gentle slope which permits distributaries to be carried in any one of several directions. Here again considerations must be carefully balanced between steep narrow canals and very gently graded distributaries of larger cross section. Consideration must also be given to the method and cost of ultimate operation and maintenance of the works. In the private canals built by the pioneers the first consideration was economy of construction; the ultimate cost of keeping up the works was given little thought. In the enterprises of the Reclamation Service, however, where there are ample funds to cover the first cost, a larger consideration is given to the cost of the resultant methods of handling the water.

In connection with the topographic mappings, careful attention is also given to the exact location of the boundaries and corners of the farms and tracts within the project. This work in many cases has disclosed errors in the location of existing fences. It has been necessary, as a rule, to reëstablish the old corners of the vacant public lands and, in some cases, to call for an entirely new survey and subdivision. The ensuing complications have often been extremely vexing, especially where groups of settlers have taken up lands whose exact boundaries were unknown and where re-survey has disclosed conflicting claims and overlapping areas. It is, of course, frequently impracticable to lay out a distributing system until these difficulties have been adjusted.

Preparation of Plans and Specifications. The preparation of plans is done, as far as practicable, upon the ground itself, in contradistinction to having a mass of notes sent to a central office to be worked up. It is believed that no matter how carefully prepared field notes and comments may be, there are always some conditions which, although well known to the man in the field, cannot be imparted in their full significance to the designer at a distance. It is believed to be far more economical to bring the designer to the work than to bring the work to some central office.

Specifications, however, are worked up mainly in the Washington office in order that there may be uniformity. Standard specifications are now in use for the great majority of items. In the development of these standards during the early days of the Service's work, the preliminary drafts were submitted for criticism to men experienced in contracting, both from the government standpoint and from that of the contractors themselves. As a basis, all of the existing forms which could be obtained were considered, and these were modified or adapted to the use of the Reclamation Service as far as practicable.

For the projects first undertaken there were few, if any, existing precedents in the way of executed works of character

similar to those to be built. It is true that under the terms of the Carey Act private enterprise had already started upon canal systems of considerable size, but most of these were of a character hardly suitable to form a model for work by the government. The older structures were usually of wood and were temporary in character, having been erected with the idea that by the time these had decayed, the owners would be in such financial condition as to be able to replace them with more permanent material. In each such case, due to shortage of funds and to the large interest charges, it was necessary to build as cheaply as possible. The investors, as a rule also, were concerned mainly with getting water to the lands at the earliest possible date, so that these might be sold and the responsibility of the works transferred to other hands before they became seriously impaired by age.

In the case of the government, however, there were relatively large funds available, and no difficulties to be met with reference to interest charges or profits to the investor. It was found more economical in the long run to build permanent structures of concrete and steel than to use wood. Because of this fact, as above noted, it was necessary for the engineers of the Reclamation Service to act as pioneers as regards permanent construction. When the first works were undertaken, shortly after the passage of the Reclamation Act in 1902, there were relatively few figures available as to the actual cost of similar structures, and little was known of the difficulties of work of this kind under the conditions obtaining. It was thus necessary to make assumptions regarding the probable cost of materials and of labor at future periods and at remote places, many of which were afterwards found to be erroneous.

Construction of Projects. Authorizations to proceed with the construction of particular units or portions of a project are made by the Secretary of the Interior, and, since 1915, within the limitations of the appropriation annually made by

Congress for such project. Such appropriations are made upon the basis of estimates submitted by the Secretary to Congress in the Book of Estimates; and a regular procedure is in force in the Service for collecting annually from the several project engineers estimates of the cost of construction on their projects during the ensuing fiscal year. Although these estimates are presented to Congress in great detail, the precise portion of the project and character of the work to be done on it being specified, the appropriation granted by Congress is in the form of a lump sum for each project, covering continuation of construction, operation and maintenance. In addition, the Secretary is authorized to transfer not more than 10 per cent. of the appropriation for any given project to other projects. A considerable discretion, therefore, still remains in the Secretary, or in effect, in the Director of the Service, in determining the speed with which and direction in which construction shall be carried forward.

Upon the receipt of authorization to proceed with construction, determination is made as to whether the several sections of the work can be constructed more economically by contract or by the Service directly through its own forces. The contract method is employed for all ordinary construction where the character and amount of the work to be done can be definitely anticipated and described. Where, however, a piece of construction involves many uncertainties and is liable to interruption by floods, the Service does the work itself. The construction of the foundations of dams, where the character of the rock which may be found in the river bed cannot readily be ascertained in advance, is an example of the kind of construction commonly done directly by the forces of the Service. The reasons for the adoption of this policy of direct employment by the Service were well stated by the Director of the Service in a hearing before the Committee on Arid Lands in 1910. Instancing a type of construction work which was liable to sudden destruction by flood, he said: "An experienced business man must figure on

a considerable profit as an offset to the risk he runs of having his investment destroyed by a sudden flood. . . . If the contractor is lucky he makes a big bonus; and if he is unlucky the government practically assumes the risk and the loss. The contractor fails and we have a lawsuit on our hands."

Construction by Contract. In planning for the letting of contracts for construction, the attempt is made, where the nature of the work permits, as in the case of long canals and distributing systems, to divide the job into units small enough to be undertaken by local persons with limited capital, in some cases even by a farmer or group of farmers who may own the necessary teams and tools. Even in these cases, however, large contracting firms are usually invited to submit bids for any or all of the units. In some cases the farmers because of their location and other facilities are able to underbid the outside contractor; in other cases where the work is especially heavy, the professional builder has the advantage.

Prior to the receipt of bids, the widest possible publicity is sought. Advertising is placed in local papers and in current periodicals generally seen by contractors, posters are displayed in prominent places and letters are sent to all the contractors whose addresses can be obtained and who are likely to be interested in the work. In addition, every possible effort is made to discover in advance the conditions which will be met on the work and thus make it easier for the bidders to form a correct judgment as to the cost of the work to be performed. In cases where the prospective work was located at points difficult of access, wagon roads have been built so that the contractor could visit the locality and could ascertain very closely the cost of bringing in men and material, and in all cases the contractor has been required to make such visit before submitting his bid. Ground of doubtful quality has been opened and rock quarried to exhibit the quality of the material to be handled.

Sealed bids are received and opened publicly at the time

and place named in the advertisements. Suitable officers are designated to form a board which opens the bids in the presence of bidders and others interested. The bids, which are usually called for on a unit basis, are then studied, and a recommendation made as to the award of the bid to the best and usually the lowest bidder. Where all bids are recommended for rejection, or where the lowest bid is not accepted, the reasons are required to be given, and evidence presented in such form as to meet the criticism of rejected bidders or other persons. Especially in the early stages of the work, great care was necessary in the award of contracts as there were a number of firms formed for the express purpose of bidding on reclamation work, many of which were composed of persons without experience in construction, who were obsessed with the idea that all government contracts were profitable.

All of the contracts provide that in case of failure to execute the work properly and within the required time, the United States can declare the contract forfeited, take over the unfinished work, together with the plant and equipment, and finish the work at the cost of the contractor. Occasionally, it is found necessary to contract for the performance of certain work without competitive bidding. This is done only on the express authorization of the Secretary of the Interior.

Work done by contractors is regularly inspected by the engineers of the Service. The problem of inspection of contract work was discussed by the Director of the Service in 1910 before the Committee on Arid Lands. He stated:

When the contracts are awarded and work begun the next matter of prime importance is to secure good inspection and to hold the contractor to the faithful performance of the terms of the contract. That is where the main difficulty of the contract lies, in getting good inspectors who will exercise common sense and will hold the contractor to full performance of what he agreed to do. Many contractors apparently have

an idea that in working for the government they should not be held to the exact letter and spirit of the specifications, but that they may do what they consider a good job. There is no discretion in such matters, and a contract once signed, it is our business to see that it is fully carried out.

Construction by the Service. The instances in which the Service itself carries on the construction work have already been described.

In carrying on work by government forces it has been found advisable to follow as nearly as possible the methods employed in connection with contract work. Plans and specifications are prepared. An engineer of the Service is put in charge of the work, and another is detailed to act independently as inspector. The engineer in charge is required to keep records similar to those kept by contractors, and from these the supervising engineer is able to ascertain whether the cost is being kept within that at which bids were or might have been received.

In connection with the direct carrying on of construction work by the Service, mention should be made of the operation by the Service of plants at several of its projects for the manufacture of the cement used in construction. Of these the largest was the cement plant operated at Roosevelt, Arizona, in the construction of the Roosevelt dam on the Salt River Project. The total cost of construction and operation of this plant was over a million dollars, and a saving of approximately $600,000 over the lowest cost for delivery from outside sources was effected.

Sand cement plants were also operated on the Elephant Butte, Truckee-Carson, and Boise Projects. The total net saving to the Service by the operation of these three plants is computed at approximately $562,000.

Similarly, several small coal mines have been opened and operated to supply fuel for construction purposes under conditions where there happened to be outcrops of coal near localities where work was going on and where it was cheaper

to procure fuel in this way than to haul it from some distant railroad point. The largest undertaking, however, is that of the permanent mine opened and operated in connection with the Williston Project in North Dakota.

Activities Incidental to Construction. In connection with some construction jobs, whether carried on by contract or by government forces, the Service finds it desirable to operate various types of enterprise and services for the benefit of the men employed in construction. Thus it has in the past operated messes, hospitals, mercantile stores and recreational facilities.

Because the work of the Reclamation Service is situated in remote places in the western part of the United States, it is necessary to operate messes at which to supply the men with wholesome food. These messes are operated on practically a cost basis, the men are furnished three meals a day at the rate of 25 cents a meal or 75 cents a day. When more than fifty men eat at the messes, a steward is placed in charge, as a rule, and is held responsible for their management. The operation of messes netted the Reclamation Service $103,-209.11 to June 30, 1917.

During the construction work on a project where the employees, largely transient laborers, are quartered in a central camp remote from towns, it is usually necessary to make provision not only for camp sanitation but also for surgical or hospital facilities. To meet these needs, the Reclamation Service establishes a hospital and employs a physician and nurses. The charge for this service is $1 to $1.50 a month and is deducted from the men's pay and credited to the hospital fund. The hospital operations netted the Reclamation Service $26,836.33 to June 30, 1917.

Mercantile stores are established by the Reclamation Service in central camps for the purpose of expediting the work of the Service, but primarily to supply necessaries so that the laborers will not be tempted to leave the work and go to the nearest town for the purchase of supplies regularly needed

by them. These operations netted the Service $338,541.00 to June 30, 1917.

The operation of amusement enterprises was forced upon the Service because of the difficulty of keeping competent men on the works, especially where these were located at remote points. Under the eight hour provision of the reclamation law no man may be allowed to work more than eight hours in one day. In a camp out on the desert or among mountains miles from other inhabited localities the opportunities for effectively spending the resultant leisure hours are limited. Under these conditions the most strenuous efforts are needed to keep alcoholic liquors out of camp and to maintain orderly communities. Some outlet for energy must be provided and experience has shown in the case of contractors camps similarly situated that it is a matter of economy to provide harmless amusements such as those advocated by the industrial department of the Y. M. C. A. Accordingly, arrangements have been made with the latter to provide skilled men to organize these activities. The small expense incurred is amply justified because of the demonstrated fact that in the end higher efficiency and economy are produced by keeping on the job the skilled men and those who have been trained to work together in well organized gangs. The amusement provided has sometimes taken the form of moving picture shows, accompanied by the sale of cold soft drinks in the hotter countries or by pastry and confectionery in the northern latitudes. Closely associated with these have been other facilities intended for the families of the workmen; for example, school rooms have been provided, the teacher being employed usually by the county school board.

Opening of Projects. Upon the completion of the construction of the project or of a self-sufficient unit of the project, the Service proceeds to test and season the works and to reduce any seepage which may be disclosed. When satisfactory conditions are obtained, the delivery of the water to

the irrigable lands is begun and gradually expanded until it reaches a point where the project or unit is thought to be ready for formal opening.

The charges made for the use of water during this transition period to those already owning land within the project are known as "rental" charges, being thus distinguished from the regular "operation and maintenance" charges, which are imposed when the project is formally opened by public notice. "Rental charges" early arose out of the necessities of the case and were imposed without specific legislative authorization, but by the act of August 13, 1914 (section 11), the Service was expressly empowered to impose such charges.

The formal opening of the project or unit is announced by public notice issued by the Secretary of the Interior. By the provisions of the Reclamation Act (section 4, as modified by section 5 of the act of June 25, 1910), this public notice is required to state

1. The lands to be irrigated.
2. The date when water is to be applied.
3. The limit of area per entry.
4. The charges per acre to be made.
5. The number and times of installments in which payment is to be made.

By "limit of area per entry" is meant the limit of area which will be permitted to be taken up by a single individual under the homestead laws on the public lands embraced within a reclamation project. The determination of this limit is made by the Secretary of the Interior, subject only to the restriction that it shall not be less than 10[1] nor more than 160 acres. Within these limits the Secretary of the Interior is empowered to fix the "limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question." Under this authority each 40

[1] In the original act this lower limit was 40 acres; the present provision was enacted in 1906 (act of June 27, 1906, Section 1).

acre tract is examined and the limit set for that particular tract according to its fertility and irrigability. In the case of privately owned lands the limits of 80 acres or 160 acres are usually allowed.

On projects or units begun since the act of June 25, 1910, the public lands within a project become open to entry only upon the issuance of public notice by the Secretary, after the water supply system is for practical purposes already in operation. On projects begun prior to that time, however, under the provisions of the original Reclamation Act, the public lands within a project, not deemed to be necessary for the irrigation works, remained open to homestead entry from the very beginning of the project. As a result, frequently much of this land was entered previous to the issuance of public notice. Upon such notice, announcing the limit of area per entry, it became necessary generally for the entryman to reduce the size of his entry to conform to the limit fixed.

The limits of area per entry, which have been fixed by the Secretary of the Interior, vary from 10 acres in Arizona and California to 160 acres in Montana or other cold areas, the average being about 60 acres. The disposal of the public lands within an irrigation project remains throughout under the control of the General Land Office, and it is the duty of that bureau to enforce the limit of area per entry imposed by the Secretary.

Fiscal Management of Projects. The General Land Office administers the disposal of the public lands within reclamation projects, but the Reclamation Service itself collects the charges imposed upon such lands for the construction of the irrigation works and for the maintenance and operation of the works.

By the original act, construction charges were required to be paid to the receiver of the local land office of the district in which the land was situated. All operation and maintenance charges were, however, paid to the project manager or

his representative. By act of August 12, 1912, the Secretary of the Interior was authorized to appoint fiscal agents on the several projects to receive all payments, and this was promptly done.

Payment of Construction Charges. The Reclamation Act provides that the "charges which shall be made per acre upon the land entries, and upon the lands in private ownership which may be irrigated by the waters of the said irrigation project . . . shall be determined with a view to returning to the reclamation fund the estimated cost of the construction of the project."

The construction charges per acre upon the projects completed to date by the Service vary from $22 to $93. Large variations are in some cases found between different portions of the same project, as in the case of the Minidoka project in Idaho where the charges on the several areas as developed in succession were $22, $30, $40, $56.50 and $57.50, the pioneers or those first coming and taking up the heavier burden of development paying less than those who arrived later after the roads, railroads, towns, and schools had been established.

Prior to the passage of the Reclamation Extension Act of August 13, 1914, the law required repayments in ten annual installments. By that act, the period of repayment has been extended to twenty years. Moreover, after an initial payment of 5 per cent, there is a five year period during which no payments are to be made; for five years thereafter the annual installment required is but 5 per cent, and for the remaining ten years it is 7 per cent. The purpose of this plan is of course to enable the settler in the earlier years to use all of his capital in cultivating his lands to bring about maximum production.

The requirement of an initial payment is intended as a test of the financial ability of the prospective entryman, and also of his intention actually to work the land; for it has been found by experience that where no advance charge was required, large numbers of individuals without experience or

money made entries of irrigable lands merely for the purpose of selling relinquishments, often holding the land out of use for a considerable period. It was expected, moreover, that by reason of his advance payment the entryman would acquire a financial interest such as would insure his continued good faith and increase the probability that he would utilize the land.

It should be noted that the Reclamation Extension Act, in addition to thus revising the plan of repayments as to lands subsequently subjected to the Reclamation Act, extended relief to the settlers on projects already initiated, many of whom had experienced difficulty in meeting the charges, by providing that all balances of construction charges still unpaid should be paid in twenty annual installments, the first four of 2 per cent each, the next two, 4 per cent, and the remaining fourteen, 6 per cent.

Operation and maintenance charges, although not mentioned in the original Reclamation Act, have been imposed from the very beginning of operation under the act. By act of August 13, 1914 (sec. 5), the imposition of such charges was specifically authorized, and it was further provided that "such charge shall be made for each acre-foot of water delivered; but each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge based upon the charge for delivery of not less than one acre-foot of water."

Operation and maintenance charges average about $1 per acre or when computed on the basis of water used they run from 50 cents to 75 cents per acre-foot, the number of acre-feet required for cultivation varying of course on the several projects and from season to season. These charges are applied equally to public lands entered under the terms of the Reclamation Act, and to lands within the project already in private ownership.

The repayment of construction charges is secured, as respects the public lands entered after the commencement of

the project, by the provision that "a failure to make any two payments when due shall render the entry subject to cancellation, with the forfeiture of all rights under this Act, as well as of all moneys already paid thereon." As to private lands embraced in an irrigation project, security is obtained by the mortgage of the private water users' association, to which reference has already been made.

Under authority conferred by the act of February 21, 1911, surplus water may be sold under contract to state or private irrigation projects. The act provides that "in fixing the charges under any such contract for impounding, storing, or carrying water for any irrigation system, . . . the Secretary shall take into consideration the cost of construction and maintenance of the reservoir by which such water is to be impounded or stored, and the canal by which it is to be carried, and such charges shall be just and equitable as to water users under the Government project." The sale of surplus water may be made under the act only "for the purpose of distribution to individual water users by the party with whom the contract is made;" and it further provides that the charge for the use of water made by such party shall not be "in excess of the charge paid to the United States except to such an extent as may reasonably be necessary to cover cost of carriage and delivery of such water through their works."

Operation of Works. On the engineering side the problem of operating irrigation works consists in so regulating the flow of water as to deliver to the highest point to be irrigated, at the proper season, a supply of water adequate to the needs of the crop. In addition, on the projects of the Reclamation Service it is necessary to deliver to each person having a right to water a definite amount. It, therefore, becomes necessary to have measuring devices of some kind in all distributaries and in all farm turnouts.

As stated by the Director of the Reclamation Service in

his annual report for 1914, no well recognized standard of practice has yet been developed in connection with the problems of operation and maintenance. It is of great importance, not merely for the benefit of the government reclamation projects but for that of other large systems built by private capital, that good standards be established. An important step toward such systematization of the management has been taken by the Reclamation Service in the issuance of what is known as the Use Book or Manual of Operation and Maintenance, defining such practices as are now generally accepted.

To secure efficient operation it has been found necessary to install records of delivery of water and systems of cost keeping similar to those maintained during construction. Accurate statistics are also kept to determine the cost per acre of land actually irrigated, per acre of land to which the irrigation system is ready to supply water, and per acre-foot of water stored, carried, and distributed. As the effectiveness of different designs or types of structures and ditches is determined largely by operation and maintenance costs, these cost-records are of great value in the design of future works.

Record is kept also of the amount of water delivered to each farm and its relation to crop production, thus facilitating the beneficial operation of the works.

In the operation of irrigation works, it was at first assumed that if the government employees took charge of the reservoirs and main line canals the irrigators would attend to the distribution works themselves and thus reduce the number of paid employees and consequently the annual cost, in this respect following the custom of the pioneer private canals. It was found, however, that with the heterogeneous population brought in from all parts of the country with differing nationality, religion, and experience, it was impracticable at first to secure unity of action and fairness of distribution of water among the smaller groups. For example, on a long sandy lateral where considerable care is necessary in order to force water to flow down to the farms at the lower end, the ma-

jority of the land owners living near the upper end would not exert themselves or limit their supply in favor of their neighbors living miles away at the far end, who, in turn, complained that they did not receive water at the right time or in sufficient amount and consequently could not make payment. Thus, to insure the repayment of the charges, if for no other reason, the Reclamation Service was forced to gradually take over the operations even of the smaller laterals and see to it that water was delivered to each and every farm instead of to groups of farmers.

As indicated in the preceding chapter, on certain of the projects pumping installations are necessary to insure an adequate supply of water, and the operation of these pumps and of the hydro-electric plants, which generate the power for their operation, constitutes one of the major activities of the Service. The operating methods employed differ in no essential respect from those followed in commercial practice.

As already stated, in connection with the Williston Project in North Dakota a mine is owned and operated by the Service for supplying the coal used in the generating plant.

Transfer to Water Users' Association. As has been noted, provision was made in the original Reclamation Act for the eventual operation by the irrigators themselves of the irrigation works constructed under the act, and the Secretary of the Interior was authorized to transfer the operation of the works to "the owners of the land irrigated . . . under such form of organization and under such rules and regulations as may be acceptable to the Secretary of the Interior." The act provided, however, that such transfer might be made only after the "payments required by this act are made for the major portion of the lands irrigated from the waters of any of the works." With the passage of the Reclamation Extension Act, however, which extended the time for payment of construction charges from ten to twenty years, it was provided that the transfer to a water users' association might be

made in the discretion of the Secretary of the Interior "whenever any legally organized water users' association or irrigation district shall so request."

The original act contemplated the transfer to the water users only of the canals, and provision was made for the permanent operation of the reservoirs by the Reclamation Service, it being provided that "the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the government until otherwise provided by Congress." The same section of the Reclamation Extension Act which provided that the transfer to water users might be made at any time in the discretion of the Secretary, also removed the limitation on the transfer of reservoirs by providing that the Secretary might transfer to a "water users' association or irrigation district the care, operation, and maintenance of all or any part of the project works, subject to such rules and regulations as he may prescribe."

Rules for the transfer of works to water users' associations have been prescribed by the Secretary of the Interior. The substance of these rules is contained in the following sections:

Action under this provision of the law will be taken by means of a written contract with the water-users' association or irrigation district, as the case may be.

Each such organization desiring the transfer of the care, operation, and maintenance of the project, or any part thereof, shall make application therefor to the Secretary of the Interior through the Director of the Reclamation Service, who will submit the same to the Reclamation Commission for recommendation thereon to the Secretary. Such application shall be based upon a certified copy of resolution of the governing board of the organization presenting the same, requesting the transfer, and shall be accompanied by a statement showing that the laws of the State and the charter powers of the organization authorize the acceptance of the duties resulting from such transfer. The statement shall contain appropriate reference to statute provisions, regulations and

charter powers in relation thereto. In any case the application may be approved and contract authorized conditional upon further satisfactory showing being made that the taking over of the operation and maintenance by the organization has been submitted to *all* the water-users affected and approved by a majority vote of all voting, provided at least three-fifths ($^3/_5$) of all water-users affected vote, otherwise by a majority of all water-users affected.

Except where the organization is an irrigation district a good and sufficient bond shall be given to the United States for the faithful performance of all duties required by law under the contract. Such bond shall be subject to approval by the Secretary of the Interior.

Reference has already been made to the necessity for impartial control of the irrigation works to insure an equitable distribution of the water among the several users, and to the difficulty that has been found in achieving that type of control under any form of local management. There has usually been manifested a tendency for one man of influence to obtain an undue share of water or for the majority to neglect the rights of the minority in the distribution of the supply.

For this reason the successful operation of any plan of local control involves an extended process of education of the members of the prospective association. The Reclamation Service has, therefore, encouraged the development of water users' associations on projects as soon as possible after their opening. Each owner of irrigable land, by virtue of his ownership, becomes a member of the water users' association and, as such, is urged to become interested in all that concerns the future of the project. As far as practicable these men are kept informed of general conditions through bulletins and through the local press, with the idea of gradually bringing them to the point where they will be able to work together as a unit and to take control of the distribution system.

On many of the projects there has been impatience on the part of water users to obtain control of the works because of a natural belief that they could operate them more economical-

ly and satisfactorily. At the same time the officials of the Reclamation Service have been equally desirous of turning over the rather troublesome and vexatious work of water control to responsible men selected by the water users. With the approach of the time when the Service is ready to turn over the works to local control, however, reluctance on the part of the water users to assume such control is encountered. Up to the present time two water users' associations, on the Salt River Project in Arizona, and on the Minidoka Project in Idaho, have taken over the management of the works from the Reclamation Service. In the case of the Minidoka Project the form of organization adopted has been that of an irrigation district formed under state law.

Water users' associations may also enter into contract and be appointed special fiscal agents of the United States to collect the construction and operation and maintenance charges and all penalties in accordance with section 7 of the act of August 13, 1914. It is provided, however, "that no water right applicant or entryman shall be entitled to credit for any payment thus made until the same shall have been paid over to an officer designated by the Secretary of the Interior to receive the same."

Dissemination of Information to Water Users. From the beginning of its operations the Reclamation Service has conceived it to be its duty to assist the water users on its projects in every way practicable. The development of its activities in this direction has been the natural outcome of its duty of determining the limit of area per entry on the several projects and units. This has necessitated the collation of a great deal of valuable data relative to the local soil, crop, and market conditions. In addition, in connection with the records kept of the delivery of water on the several projects, to which reference has already been made, much useful information is obtained. The project manager, moreover, is generally chosen from among the engineers who were engaged in

the construction of the project works and is, therefore, in possession of detailed information regarding local conditions. It has thus resulted that the water users on the government projects have come to depend very generally upon the judgment of the project managers in a great variety of matters and so to require an assistance and guidance which, although not contemplated in the law, are found to be essential to ultimate success.

In this work the project manager was assisted from time to time by experts detailed or transferred from the Department of Agriculture, and during the years immediately following the passage of the Reclamation Act, in 1902, it was assumed and so stated in official publications that the Department of Agriculture would take a larger and larger share in furnishing advice with regard to cultivation of crops and quantity of water to be used. Experiment stations were established on many of the projects and demonstration farms started, but it was found that the problems were so complicated that scientifically accurate data were not available in time to be of immediate service to the early settlers. As a result, it not infrequently happened that through some accident or undiscovered cause the crops on the demonstration farms were not such as to afford encouragement. Occasionally, indeed, a settler without experience and resources would obtain better results than did the expert with all facilities apparently at his command. Because of these conditions the demonstration farms were generally discontinued. In 1913 the Secretary of the Interior created the position of Supervisor of Irrigation and designated an experienced irrigator to fill the position, with orders to "advise and counsel with water users as to the best practice of irrigating and cultivating irrigated lands, the development of markets, and all questions affecting the welfare of settlers and water users."

The Service also publishes a monthly bulletin known as the Reclamation Record, which is devoted to the interests of irrigators, and which is distributed free of cost to all water users

on its projects. Begun in 1905 as hectographed sheets and distributed as a means of keeping the field employees of the Service informed of its operations, the Record, first printed in 1909, has had a steady growth in size, circulation and value. At present each issue usually occupies forty-eight pages and has a circulation of about 17,000.

CHAPTER III

ORGANIZATION

The plan of organization of the Reclamation Service is similar to that of the more highly developed construction companies. In working out the details preliminary to adopting this plan, studies were made of many existing corporations, and advice was had from experts and chartered accountants in public and private employment. The peculiar requirements of existing law and the limitations of governmental regulations necessitated some departure from ordinary business procedure, and the wide distribution of the field work, combined with seasonal variations and accidents of drought and flood, necessitated provision for a greater elasticity than is ordinarily found in government organizations.

The size of the force employed by the Service has varied widely in the several stages of its operations. The first year of its existence was consumed principally in planning work, which required a relatively small force. With the beginning of design and construction, however, the staff of the Service increased rapidly, mounting steadily from 1902, when it numbered but 20, to 1913, when no less than 8,000 employees, including day laborers, were on its rolls. Today, with most of the primary projects completed or near completion, the employees of the Service number approximately 4,000, including laborers.

As previously pointed out, the manner in which this large force of employees is organized is left by the Reclamation Act wholly to the discretion of the Secretary of the Interior, nor have subsequent enactments in any way limited this discretion.

The sundry civil appropriation act for the fiscal year 1918, although making specific allotment for each of the projects controlled by the Service, makes specific provision for the title or salary of no single employee.

In one important respect the reclamation law and its amendments do indeed control the organization of the Service. They impose upon the Secretary himself the duty of determining various specific matters, such as the limit of area per entry on each project, the construction charges to be imposed, etc. In effect, therefore, these provisions make the Secretary of the Interior himself an integral part of the Reclamation Service, and he is here so considered.

Aside, however, from the functions specifically imposed by law upon the Secretary, the present organization of the Service is determined, as to its main features, by an order of the Secretary of the Interior issued on November 22, 1915. By this order, four chief divisions of administration are created, the Executive and Engineering Division, the Legal Division, the Fiscal Division and the office of the Supervisor of Irrigation; and the heads of the first three divisions are constituted a board with general supervisory power.

In the following, the functions exercised by the Secretary of the Interior will first be considered. This will be followed by a discussion of the Reclamation Commission and then of the four administrative divisions in the order above named.

The Secretary of the Interior. The functions specifically vested in the Secretary of the Interior by the Reclamation Act and its amendments may be listed as follows:

1. Withdrawal of lands.
   1. To withdraw from entry public lands required for irrigation works. To restore to public entry any of the lands so withdrawn when such lands are no longer required for such works. (Act of June 17, 1902, Sec. 3.)
   2. To withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irri-

gation from said works. (Act of June 17, 1902, Sec. 3.)

3. To withdraw from public entry any lands needed for town-site purposes in connection with irrigation projects, not exceeding 160 acres in each case. (Act of April 16, 1906, Sec. 1.)
4. To withdraw from other disposition and reserve for country parks, public playgrounds and community centers such tracts as he may deem advisable, not exceeding 20 acres in any one township in each reclamation project. (Act of October 5, 1914, Sec. 1.)

2. To acquire rights necessary for construction.
   1. To acquire any rights or property for the United States by purchase or by condemnation under judicial process. (Act of June 17, 1902, Sec. 7.)
   2. To make any arrangement or agreement in reference to the irrigation of irrigable lands included in allotments made to Indians. (Act of April 30, 1908, 35 Stat. L., 85.)
3. To prescribe conditions of settlement on projects.
   1. To determine the limit of area per entry. (Act of June 17, 1902, Sec. 4.)
   2. To require the reclamation and cultivation of one-fourth of the irrigable area within three full irrigation seasons, and of one-half the irrigable area within five full irrigation seasons. (Act of August 13, 1914, Sec. 8.)
   3. To fix the construction charges to be imposed upon the lands reclaimed. (Act of June 17, 1902, Sec. 4.)
   4. To fix the date when operation and maintenance charges shall become payable. (Act of August 13, 1914, Sec. 6.)
   5. To designate the terms and the maximum price at which the owners of private lands within a project shall dispose of lands in excess of the area which he shall deem sufficient for the support of a family upon the lands in question. (Act of August 13, 1914, Sec. 12.)
   6. To subdivide into town lots any lands withdrawn for town-site purposes, and to direct the appraisal and sale of such lots. (Act of April 16, 1906, Secs. 1 and 2.)
4. To regulate the use of water.

1. To furnish water upon projects prior to giving public notice of the construction charge. (Act of August 13, 1914, Sec. 11).
2. To make general rules and regulations governing the use of water. (Act of August 13, 1914, Sec. 8.)
3. To contract for the delivery of water supply with the proper authorities of towns established on town sites reserved on reclamation projects, or of other towns or cities in the immediate vicinity of irrigation projects, which shall have a water-right from the same source as that of the project. (Act of April 16, 1906, Sec. 4.)
4. To contract for the impounding, storage and carriage of excess water with irrigation systems operating under the Carey Act and with individuals, corporations, associations and irrigation districts organized for or engaged in furnishing or distributing water for irrigation. (Act of February 21, 1911, Sec. 1.)
5. To appoint fiscal agents.
   1. To designate bonded fiscal agents. (Act of August 9, 1912, Sec. 4.)
   2. To appoint a water users' association as fiscal agent. (Act of August 13, 1914, Sec. 7.)
6. To transfer to a legally organized water users' association or irrigation district at its request, the care, operation and maintenance of all or any part of the project works subject to such rules and regulations as he may prescribe. (Act of August 13, 1914, Sec. 5.)
7. To enter into contracts with an organization formed by the owners of the lands within a project or project unit, providing that the organization will maintain and use lands reserved for country parks, public playgrounds and community centers for the purposes prescribed.
8. To lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or privilege which will not impair the efficiency of the irrigation project. (Act of April 16, 1906, Sec. 5.)
9. To perform any and all acts and make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of the Reclamation Act into full force and effect. (Act of June 17, 1902, Sec. 10.)

Recommendation to the Secretary for action upon all of the matters mentioned is usually made by the Reclamation Commission. He is advised upon such recommendation and upon all engineering matters in connection with the Reclamation Service by a consulting engineer, who has this as his sole function.

In addition to the functions enumerated, the Secretary exercises the power of appointment of all the chief officers and employees of the Service, including the Director.

Reclamation Commission. From 1907 to 1913, the administrative direction of the entire Service was vested solely in a Director, who was responsible directly to the Secretary of the Interior. On December 13 of that year, however, as already stated, the Secretary of the Interior ordered that—"Subject to the approval of the Secretary of the Interior, the control, direction, and management of the service shall hereafter be vested jointly in the following officers: The director, the chief engineer, the chief counsel, the comptroller, the supervisor of irrigation.

"The officers named shall constitute a board for the purpose of considering all questions of administrative policy and management, and recommending action thereon, to the Secretary of the Interior, but no act of said officers or of said board shall be of force or effect unless the same is in pursuance of authority previously given by the Secretary of the Interior. For convenient reference said board shall be known as the reclamation commission."

In December, 1914, the position of Chief of Construction was created and he was made a member of the Commission.

By order of May 6, 1915, the positions of Director and Chief Engineer were consolidated under the title of "Director and Chief Engineer" and the Supervisor of Irrigation and the Chief of Construction were relieved of membership on the Reclamation Commission. The membership of the Commission was thus reduced to three. Shortly after and during the

greater part of 1916, the Comptroller was busy with other matters and was granted leave of absence at intervals until June 30, 1917, when he resigned. Thus the Commission has, in fact, consisted of two members, the Director and the Chief Counsel, these officers alternating much of the time in the Washington office and in the field.

The function of the Commission is defined in the order of the Secretary of the Interior of May 6, 1915, above referred to, as being "to determine matters of general policy and recommend appropriate action thereon to the Secretary of the Interior." The order further provides that "no action of members individually or collectively shall become effective unless the same is in pursuance of authority previously given by the Secretary of the Interior." Because of the conditions above described there has usually been available in Washington only one member of the Commission, and even when both members are in the office the determination of matters of general policy consists in the acquiescence of one or the other officer in the letter or memorandum prepared by his colleague. In practice the Director refers important letters to the Chief Counsel if the latter is available for consultation, otherwise he proceeds without further delay—the Commission having a theoretical rather than an actual existence.

Executive and Engineering Division. The functions of the Executive and Engineering Division are not defined in the order of November 22, 1915, except as they may be inferred from the paragraphs defining the duties of the Director and Chief Engineer, who is the head of that division. So regarded, the functions of the division may be said to include, as indicated by its title, all administrative functions not vested in the three other divisions, and all engineering matters relative to the investigation, construction, operation and maintenance of projects.

Matters of the first class are handled through the main office of the Service at Washington. Matters of the second

class are handled through a branch office at Denver, known as the Office of the Chief of Construction, which is subordinate to the Director and Chief Engineer. In each office the force is organized into a number of subdivisions. The heads of these subdivisions in the Washington office report directly to the Director and Chief Engineer; those in Denver report in the first instance to the Chief of Construction.

The several primary units of the Executive and Engineering Division are therefore as follows:

1. Office Proper of the Director and Chief Engineer.
2. Administrative Offices (Washington, D. C.).
    1. Office of Chief Clerk.
    2. Accounting Division.
    3. Reclamation Settlement Division.
    4. Engineering Division.
    5. Editorial Division.
    6. Fiscal Inspectors.
3. Office of Chief of Construction (Denver).

Office Proper of the Director and Chief Engineer. The Director and Chief Engineer is appointed by the Secretary of the Interior and receives a salary of $7,500 per annum.

By the Secretary's order of November 22, 1915, already cited, the Director and Chief Engineer is made "the executive officer of the Service." By the same order, however, he is specifically denied control of the legal division of the Service, and of the Comptroller, and inferentially as well of the Supervisor of Irrigation. It would appear, therefore, that the words "executive officer of the Service" are applicable to his functions as thus limited, only in that he is the most important of the three executive officers of the Service created by the order, the portion of the organization placed under his control being far larger and more basic than are those placed under the control of the other offices.

The order vests the Director and Chief Engineer specifically with control over "all employees engaged in investigating, constructing, operating and maintaining projects" and

over "all employees of the Washington office except the Legal Division and the Comptroller."

In addition to the function of supervision over the general administrative and the engineering units of the Service thus vested, the Director and Chief Engineer is specifically charged by the order with the duty to "issue all instructions required to carry out approved policies and for executing the necessary work through the executive office at Denver," and to "control an administrative examination of all accounts in Washington," and he is empowered "to sign any contracts and make any commitments authorized by the Secretary of the Interior."

Office of Chief Clerk. Under the office of the chief clerk are included all of the sections having to do with the general business activities of the Service.

This includes:

1. Office Proper of the Chief Clerk.
2. Appointment Section.
3. Purchase and Supply Section.
4. Mails and Files Section.
5. Stenographic Section.
6. Messengers.
7. Janitor, Elevator, and Watch Service.

Accounting Division. All accounting work of the Service, including that of the field offices, is coördinated under a chief accountant. The accounting accuracy of the project accounts is insured by appropriate controlling accounts in the Washington office. The accountants stationed in the several field offices are, however, under the direction of the officers in charge of those offices.

The work of this division is divided into the following sections:

1. Office Proper of the Chief Accountant.
2. Administrative Examination of Disbursing Accounts.
3. Administrative Examination of Revenue and Repayment Accounts.

4. Bookkeeping, Costkeeping, and Statistical Section.
5. Transportation Section.
6. Special Fiscal Agent (Disbursing Officer).

Reclamation Settlement Division. The function of the Reclamation Settlement Division is to disseminate information relative to the reclamation projects, in order to encourage the settlement and development of the reclaimed lands. For this purpose newspaper and magazine articles are prepared relative to the agricultural and business opportunities on projects, and coöperative relations are maintained with the water users' associations, the immigration agents of the states, railroad companies, and others, with a view to securing competent settlers for the lands.

Because of the value of photographs of the reclamation projects in the publicity work referred to, the Settlement Division has charge also of all the photographic work done by the Service. That work has, however, a value quite apart from its utilization for publicity. In all operations of this kind it is highly desirable to have photographs of the original condition of the ground or of structures which are to be removed, repaired, or modified; also of the progress made by contractors engaged in difficult work. By having such photographic records in connection with drawings and manuscript, it is possible to avoid many misunderstandings and to prevent litigation arising.

Engineering Division. The engineering work carried on in the Washington office is divided into two sections, known as the Technical Section and the Drafting Section. The Technical Section has for its duty the review and standardization of specifications and plans, the preparation of engineering articles for engineering and other publications, the tabulation of engineering statistical data, and other matters of engineering detail. The Drafting Section has for its duty the maintenance and reproduction of all maps, drawings, plates, survey records, and so forth arising from the work of the Service.

Editorial Division. The editor handles all matters relating

to the publication of the Reclamation Record, a monthly publication; and edits the annual reports of the Service, and other reports and material preparatory to their publication.

Examiners of Accounts. Three examiners of accounts are employed to inspect and audit the accounts maintained in the several project offices and to advise those offices as to the methods of keeping such accounts. Prior to July 1, 1917, this work was under the direction of the Comptroller, irregularities noted by the inspectors being reported by them to the Comptroller, who brought them to the attention of the Director and Chief Engineer for rectification. Upon the position of Comptroller becoming vacant, on the date mentioned, the three examiners of accounts were placed directly under the jurisdiction of the Director and Chief Engineer.

Office of Chief of Construction (Denver). The Chief of Construction is the field executive of the Director and Chief Engineer. He is appointed by the Secretary of the Interior and receives a salary of $6,000 per annum. He has immediate supervision over the management and execution of all work in the field; his office is located at Denver.

The duties of the Chief of Construction are thus defined in the order of the Secretary of the Interior, dated November 22, 1915:

> The Chief of Construction shall represent the executive officer in the field and shall have charge of the Denver Office and all employees engaged in the construction, operation, and maintenance of the projects and works incident thereto. He shall report to the Director and Chief Engineer, and, subject to the latter's general approval, shall adopt the measures necessary to execute the approved plans and policies.

The Chief of Construction thus has under his control an office force located in the Denver office, and a field force stationed on the twenty-six projects.

The sections of the office force, stationed at Denver, are as follows:

1. Office Proper of Chief of Construction.
2. Engineering Section.
3. Disbursing Section.
4. Purchasing Section.
5. Consulting Engineers.

In the Office Proper of the Chief of Construction are two Assistant Chiefs of Construction.

The so-called Engineering Section is in fact composed of four coördinate engineering sections, headed by an electrical engineer, a designing engineer, a drainage engineer and an office engineer respectively. The electrical engineer advises the Chief of Construction on mechanical and electrical engineering matters and supervises the design and examination of plans submitted for approval of permanent mechanical and electrical installations. The designing engineer supervises the designing and drafting done in the Denver office and acts in an advisory capacity in the examination of all plans and designs submitted for approval with the exception of mechanical and electrical work. The drainage engineer advises the Chief of Construction on drainage matters and acts in an advisory capacity to the project managers on drainage problems. The office engineer assists the Chief of Construction on engineering details, examines contracts and specifications, and supervises the inspection of materials purchased under contract.

The Disbursing Section has to do with the disbursement of moneys for purchases made through the Denver office and the payment of payrolls and other vouchers transmitted to the Denver office for payment.

The purchasing agent supervises all purchases and transfers of property made through the Denver office.

The work of a Cement Testing Section which supervised the testing and shipping of cement, formerly a part of the Denver organization, was transferred recently to the Bureau of Standards of the Department of Commerce.

In addition to the above organization, a staff of consulting engineers is retained, and where considered necessary the

Chief of Construction calls upon these engineers to act individually in an advisory capacity on special engineering questions submitted to them or with boards of engineers appointed to make recommendations regarding engineering features of reclamation projects.

The field organization of the executive and engineering branch embraces, as above stated, twenty-six projects.

During the initial stages of the Service's work, the engineer in charge of each separate field party or project reported to the Chief Engineer (located at the Washington office); but as the number of enterprises increased it became impossible for the Chief Engineer to give personal attention to all details. There were accordingly created six districts, each with a supervising engineer in charge who reported to the Washington office and acted as the immediate representative in the field of the Chief Engineer. With the completion of the larger structures the number of districts was reduced to three, the engineer in charge of a district being designated senior engineer instead of supervising engineer. In 1916 the area was again divided and four senior engineers' divisions were established, known as the Central, Southern, Northern, and Pacific Divisions. The senior engineer in charge of each division had duties in addition to that of supervision of his district; the senior engineer in charge of the Central Division acting also as assistant to the Chief of Construction, and each of the other three senior engineers acting also as a project manager. These territorial divisions have recently been abolished, and each project manager now reports direct to the Chief of Construction.

The projects, arranged alphabetically by states, are as follows:

State	Project	Office
Arizona	Salt River	Phoenix, Ariz.
Arizona-California	Yuma	Yuma, Ariz.
California	Orland	Orland, Cal.
Colorado	Grand Valley	Grand Junction, Colo.
Colorado	Uncompahgre Valley	Montrose, Colo.

State	Project	Office
Idaho	Boise	Boise, Idaho
Idaho	King Hill	King Hill, Idaho
Idaho	Minidoka	Burley, Idaho
Montana	Huntley	Huntley, Mont.
Montana	Milk River	Malta, Mont.
Montana	Sun River	Fort Shaw, Mont.
Montana-North Dakota	Lower Yellowstone	Savage, Mont.
Nebraska-Wyoming	North Platte	Mitchell, Neb.
Nevada	Truckee-Carson	Fallon, Nev.
New Mexico	Carlsbad	Carlsbad, N. Mex.
New Mexico	Hondo	Carlsbad, N. Mex.
New Mexico-Texas	Rio Grande	El Paso, Tex.
North Dakota	N. Dak. Pumping	Williston, N. Dak.
Oklahoma	Lawton [1]	
Oregon	Umatilla	Hermiston, Ore.
Oregon-California	Klamath	Klamath Falls, Ore.
South Dakota	Belle Fourche	Newell, S. Dak.
Utah	Strawberry Valley	Provo, Utah
Washington	Okanogan	Okanogan, Wash.
Washington	Yakima	Yakima, Wash.
Wyoming	Shoshone	Powell, Wyo.

[1] Work on this project has been postponed until after the war.

On each project is a project manager in responsible charge. It is his duty to direct the work in all its phases, including the operation and maintenance of completed portions of the systems. The project manager has an office force and a field force. The office force has for its duties the planning of the construction work, the planning of water deliveries for the project as a whole, the compilation of records of deliveries, the collection and disbursement of money, and the office correspondence. The field force has for its duties the actual construction involved in building physical features of the projects, and after construction the proper distribution of the water and the maintenance of the irrigation works. Members of the office force frequently assist in the inspection of field work. The size and the detailed duties of these forces will necessarily vary with the extent and conditions on each project.

The field force employed for the operation of the works is usually drawn from the working force which built the canals and is thus composed of men who had become thoroughly acquainted with all the details. In any system of earth works

there are so many things out of sight that it is not safe to trust such works in the hands of men who do not know their past history or the methods used in their construction.

If the system consists of several large canals, each is in charge of a superintendent who, in turn, has under him two or more water masters, each in charge of large subdivisions. At the head of the system, near the gates which control the outflow of water from the reservoir or at the inflow to the canals, is located a gate tender who, with his family, resides at the spot so that some competent person is always available to be reached by telephone and to manipulate the gates. At convenient points along the principal canals are located various canal riders known in the southwest as "zanjeros," the duty of each being to ride daily 20 miles or more of the canal, see that it is in good condition, and open or close the water gates leading from the main canal into the laterals and, from these, to the farmers' distributing systems. These men usually need two horses for use on alternate days, or are provided with motorcycles or light automobiles to facilitate the work. The men are paid from $75 to $90 per month, depending upon their experience, the difficulty of the work, facilities in the way of lodging and transportation furnished to them, and the number of months employed. In the northern states, where the irrigation season is short, many of them are kept busy only during the summer and seek other occupations during the remainder of the year. It is, however, difficult to get back on the work the good men for the summer season and, hence, it is frequently necessary to furnish employment to these men in some other line on the project throughout the year.

Legal Division. The work of the legal branch embraces the acquisition of water rights and rights of way, and the purchase of land, the examination of titles, the preparation of public notices, the interpretation of laws and rules, and all other legal matters arising out of the work of the Service.

The legal branch is organized in the following units:

1. Office Proper of the Chief Counsel.
2. Law Section.
3. Land and General Section.
4. District Offices (nine in number).

Office Proper of the Chief Counsel. The Chief Counsel is the chief law officer of the Service and is a member of the Reclamation Commission. He is appointed by the Secretary of the Interior and receives a salary of $6,000 per annum.

In the order of November 22, 1915, the Secretary states that

> The Chief Counsel, as the head of the legal division, shall conduct all investigations involving the legal rights and privileges of the Service, and will control all employees of his division.

As a member of the Commission the Chief Counsel assists in matters of administration. In testimony before the subcommittee of the House Committee on Appropriations, in charge of the sundry civil appropriation bill for 1916, he stated that probably half of his time is taken up with work that cannot be termed legal work.

Law Section. The Law Section looks after strictly legal matters and has for its duty the preparation of opinions upon the numerous legal questions continually arising.

Land and General Section. The work of the Land and General Section is chiefly along administrative lines, including the withdrawal and restoration of lands and routine examination of contracts, examination and amendment of farm unit plats, etc. This section also handles much of the routine correspondence of the Washington office of the Service.

District Offices of the Legal Division are maintained at nine points in the west for the purpose of handling legal matters arising out of the construction and maintenance of the several projects, such as negotiations for the purchase of land, the filing, purchase and adjustment of water rights, and the prepara-

tion of construction contracts, public notices, and agreements with water users' associations; and of furnishing legal advice to the field forces of the Executive and Engineering Division. Each office is in charge of a District Counsel who, in addition to the work just mentioned, frequently assists the United States attorneys in the preparation and trial of cases involving the Service.

The location of these field offices, together with the projects or other assignments within the jurisdiction of each District Counsel is given below:

1. Denver, Colorado.
    1. Office of the Chief of Construction.
    2. Organization of Irrigation Districts.
    3. Contracts.
2. Montrose, Colorado.
    1. Grand Valley Project, Colorado.
    2. Uncompahgre Valley Project, Colorado.
    3. Strawberry Valley Project, Utah.
3. El Paso, Texas.
    1. Rio Grande Project, New Mexico-Texas.
    2. Carlsbad Project, New Mexico.
    3. Hondo Project, New Mexico.
4. Los Angeles, California.
    1. Salt River Project, Arizona.
    2. Yuma Project, Arizona-California.
    3. Orland Project, California.
    4. Truckee-Carson Project, Nevada.
    5. Titles.
5. Portland, Oregon.
    1. Umatilla Project, Oregon.
    2. Klamath Project, Oregon-California.
6. Yakima, Washington.
    1. Yakima Project, Washington.
    2. Okanogan Project, Washington.
7. Boise, Idaho.
    1. Boise Project, Idaho
    2. Minidoka Project, Idaho.
    3. King Hill Project, Idaho.
    4. Jackson Lake Enlargement, Wyo.

8. Helena, Montana.
   1. Blackfeet (Indian) Project, Montana.
   2. Flathead (Indian) Project, Montana.
   3. Fort Peck (Indian) Project, Montana.
   4. Huntley Project, Montana.
   5. Milk River Project, Montana.
   6. Sun River Project, Montana.
   7. North Dakota Pumping Project, North Dakota.
   8. Lower Yellowstone Project, Montana-North Dakota.
   9. Shoshone Project, Wyoming.
9. Scottsbluff, Montana.
   1. North Platte Project, Nebraska-Wyoming.
   2. Belle Fourche Project, South Dakota.

Fiscal Division. The Fiscal Division was created by order of the Secretary on December 13, 1913, and was continued by the order of November 22, 1915. By that order its function was defined to be "the inspection of all fiscal practices and accounts," the Executive and Engineering Division being entrusted with the "administrative examination of accounts," and with the actual keeping of the accounts. The nominal head of the Fiscal Division was for about three years—1913 to 1916—the Comptroller who, as already stated, was by the same orders designated a member of the Reclamation Commission. The Fiscal Division had, however, but a short life as an independent division of the Service, as the Comptroller was granted successive leaves of absence during a great part of 1916 and 1917, finally resigning on June 30, 1917. The several examiners of accounts under his jurisdiction were on the latter date transferred to the Executive and Engineering Division, reporting directly to the Director and Chief Engineer.

The Fiscal Division has, therefore, no longer any real existence, and mention is made of it in this place only because it is recognized as an independent division in the Secretary's order of November, 1915, which has not yet been rescinded.

Office of the Supervisor of Irrigation. The position of Supervisor of Irrigation was created by the Secretary of the Interior by his order of December 13, 1913. By the order of November 22, 1915, he is directed to "advise and counsel with water users as to the best practice of irrigating and cultivating irrigated lands, the development of markets, and all questions affecting the welfare of settlers and water users," and to "consult and coöperate with the experts of the Agricultural Department that are assigned to the projects, and advise the executive officer of the Reclamation Service regarding all irregularities in the operating departments of the respective projects that may come to his notice through inspection or otherwise."

The Supervisor of Irrigation maintains his office at Billings, Montana, where he is assisted by a secretary. He is appointed by the Secretary of the Interior and receives a salary of $21 a day and expenses when engaged on Reclamation Service work. He has visited most of the projects at intervals of several months, held popular meetings with the irrigators, urged the extension of area planted to alfalfa, and better farming methods in general, and is a monthly contributor to the Reclamation Record on subjects relating to better farming.

APPENDIX 1

OUTLINE OF ORGANIZATION

Explanatory Note

The Outlines of Organization have for their purpose to make known in detail the organization and personnel possessed by the several services of the national government to which they relate. They have been prepared in accordance with the plan followed by the President's Commission on Economy and Efficiency in the preparation of its outlines of the organization of the United States government.[1] They differ from those outlines, however, in that whereas the Commission's report showed only organization units, the presentation herein has been carried far enough to show the personnel embraced in each organization unit.

These outlines are of value not merely as an effective means of making known the organization of the several services. If kept revised to date by the services, they constitute exceedingly important tools of administration. They permit the directing personnel to see at a glance the organization and personnel at their disposition. They establish definitely the line of administrative authority and enable each employee to know his place in the system. They furnish the essential basis for making plans for determining costs by organization division and subdivision. They afford the data for a consideration of the problem of classifying and standardizing personnel and compensation. Collectively, they make it possible to determine the number and location of organization divisions of any particular kind, as, for example, laboratories, libraries, blue-print rooms, or any other kind of plant possessed by the national government, to what services they are attached and where they are located, or to determine what services are maintaining stations at any city or point in the United States. The Institute hopes that upon the completion of the present series, it will be able to prepare a complete classified statement of the technical and other facilities at the disposal of the government. The present monographs will then furnish the details regarding the organization, equipment, and work of the institutions so listed and classified.

[1] House Doc. 458, 62d Cong., 2d Sess. 1912—2 vols.

OUTLINE OF ORGANIZATION
RECLAMATION SERVICE
DEPARTMENT OF THE INTERIOR

June 30, 1917

Note: The names of the divisions of the Service appearing in this outline are of two classes—those corresponding to distinct organization units, and those used merely as convenient group names to designate a group of related but independent organization units. The name of each organization unit proper is followed by the title of the head of the unit, except where the title is self-evident.

	No.	*Salary Rate*
1. Secretary of the Interior		
Consulting Engineer to the Secretary of the Interior	1	$ 5,000
2. Reclamation Service Proper—Reclamation Commission ([1])		
1. Reclamation Commission		
Director and Chief Engineer, Chairman		
Chief Counsel		
Comptroller (Position vacant)		
2. Executive and Engineering Division—Director and Chief Engineer		
1. Office Proper of the Director and Chief Engineer		
Director and Chief Engineer	1	7,500
Private Secretary	1	1,800
Stenographer	1	1,200
2. General Administrative Offices		
1. Office of Chief Clerk		
1. Office Proper of Chief Clerk		
Chief Clerk	1	2,100
Stenographer	1	1,440
2. Appointment Clerk	1	1,560
3. Purchase and Supply Section—Purchasing Agent		
Purchasing Agent	1	1,800
Asst. Purchasing Agent	1	1,680
Stenographer and Clerk	1	1,440
Storehouse Clerk	1	1,080
Asst. Storehouse Clerk	1	900
" " "	1	840
Wrapper	1	480
4. Mails and Files Section—Clerk in Charge		
Clerk in Charge	1	1,980

[1] This term was used in the original order creating this body—that of December 13, 1913. The revised order now in force—that of November 22, 1915—does not contain any specific designation for the commission.

File Clerk	1	1,680	
Assistant File Clerk	1	1,500	
Index Clerk	1	900	
Mailing Clerk	1	480	
5. Stenographic Section—Stenographer in Charge			
Stenographer in Charge	1	1,620	
Stenographer	1	1,380	
"	1	1,320	
"	1	1,080	
"	1	1,020	
"	1	1,000	
"	1	3	pd
6. Messengers			
Messenger	1	540	
"	4	480	
7. Janitor and Watch Force			
Janitor	1	1.75	pd
Charwoman	7	.75	pd
Watchman	2	720	
2. Accounting Division—Chief Accountant			
1. Office Proper of Chief Accountant			
Chief Accountant	1	2,700	
2. Administrative Examination of Disbursing Accounts			
Chief of Section	1	1,920	
Clerk	1	1,620	
"	1	1,440	
"	1	1,380	
3. Administrative Examination of Revenue and Repayment Accounts—Chief of Section			
Chief of Section	1	1,920	
Bookkeeper	1	1,680	
"	2	1,440	
"	1	1,260	
"	1	1,080	
"	1	1,020	
4. Bookkeeping, Costkeeping and Statistical Section—Head Bookkeeper			
Head Bookkeeper	1	1,800	
Bookkeeper	1	1,680	
"	1	1,440	
Clerk	1	480	
5. Transportation Section—Chief of Section			
Chief of Section	1	2,220	

Freight Rate Clerk	1	1,500
" " "	1	1,440
Stenographer	1	1,200
Clerk	1	1,020
6. Special Fiscal Agent	1	1,800
3. Reclamation Settlement Division—Statistician		
1. Office Proper of Statistician		
Statistician	1	3,300
2. Settlement and Publicity Section—Assistant Statistician		
Assistant Statistician	1	1,500
Settlement Agent (Chicago)	1	1,320
Stenographer	1	900
Clerk	1	840
"	1	480
Colorist	1	Piece work
3. Photographic Section—Photographer		
Photographer	1	1,020
Assistant Photographer	1	600
4. Engineering Division—Engineer in Charge		
1. Office Proper of Engineer in Charge		
Engineer in Charge	1	2,520
Assistant Engineer	1	1,860
" "	1	1,680
Stenographer and Clerk	1	1,320
2. Drafting Section		
Draftsman in Charge	1	1,800
" " "	2	1,680
" " "	1	1,620
" " "	1	1,140
Assistant Map Printer	1	600
Apprentice Draftsman	1	540
5. Editor	1	2,400
6. Examiners of Accounts		
Examiner of Accounts	1	2,160
" "	1	2,100
3. Field Establishment—Chief of Construction		
1. Office Proper of Chief of Construction (Denver, Colo.)		
Chief of Construction	1	6,000
Assistant Chief of Construction	1	4,500
Office Engineer	1	3,000
Assistant Engineer	2	1,920
Consulting Engineer	1	3,600
Stenographer	2	1,260

Chief Clerk	1	2,160
Appointment Clerk	1	1,440
Costkeeper	1	1,680
Bookkeeper	1	1,680
"	1	1,380
File Clerk	1	1,620
Assistant File Clerk	2	840
Stenographer	1	1,080
Timekeeper	1	40 pm
Telephone Operator	1	50 pm
Messenger	1	600

2. Central Offices (Denver, Colo.)
   1. Engineering Offices
      1. Electrical and Mechanical Engineering Section—Electrical Engineer

Electrical Engineer	1	3,900
" "	1	2,760
Assistant Electrical Engineer	1	2,040
Mechanical Draftsman	1	1,800
" "	3	1,560
Under Clerk	1	900

      2. Designing Engineering Section—Designing Engineer

Designing Engineer	1	3,900
Assistant Designing Engineer	4	1,920
" " "	4	1,440
Draftsman	1	1,140

      3. Drainage Engineer — 1 — 3,900
      4. Consulting Engineers

Consulting Engineer	4	25 pd
" "	3	20 pd
" "	1	18 pd
" "	1	14 pd
" "	1	2,520
Junior Clerk—Steno.	1	1,200

   2. Business Offices
      1. Purchasing Section—Purchasing Agent

Purchasing Agent	1	2,400
Purchasing Clerk	1	1,800
Clerk	1	1,260
"	1	1,200
"	2	1,140
"	1	1,080
"	1	1,020
"	1	900
"	1	660

	Clerk	1	3 pd
	Messenger	1	480
	2. Disbursing Section-Disbursing Officer		
	Disbursing Officer	1	1,920
	Ass't Disbursing Officer	1	1,560
	Clerk	1	1,320
	"	2	1,080
	Messenger	1	540
3. Projects			
1. Salt River Project (Arizona)			
2. Yuma Project (Arizona-California)			
3. Orland Project (California)			
4. Grand Valley Project (Colorado)[1]			
	1. Office Proper of Project Manager (Grand Junction, Colo.)		
	Project Manager	1	2,400
	Stenographer	1	1,140
	2. Office of Chief Clerk[2]		
	Chief Clerk	1	1,800
	Special Fiscal Agent	1	1,260
	Clerk	1	1,320
	"	1	1,080
	Storekeeper	1	105 pm
	Timekeeper	1	95 pm
	"	1	90 pm
	3. Engineering Division (1)		
	Assistant Engineer	1	2,160
	" "	1	1,680
	" "	1	1,620
	" "	2	1,500
	Junior Engineer	1	1,380
	Foreman	1	145 pm
	"	1	110 pm
	"	1	4.00 pd
	"	1	3.92 pd
	Subforeman	1	3.40 pd

[1] The organization of this project is presented in detail for purposes of illustration. The organizations of the remaining projects do not differ essentially from that presented.

[2] The outline given includes only such employees as are employed fairly regularly throughout the year. During the months that construction work is practicable and during the operating season, the forces of the projects are materially increased in the number of gate tenders, ditch-riders, water distributors, mechanics and laborers, and of engineers, instrumentmen, surveymen, clerks, storekeepers, timekeepers, shop clerks and the like.

Machinist Foreman	1	4,25 pd
Blacksmith	2	4.00 pd
Instrumentman	1	125 pm
"	1	110 pm
"	1	80 pm
Transitman	1	100 pm
"	2	90 pm
Levelman	2	90 pm
Rodman	3	70 pm
Chainman	1	70 pm
4. Operation and Maintenance [1]		
Supt. of Irrigation	1	150 pm
Superintendent	1	150 pm
Gatetender	1	90 pm
Ditchrider	1	105 pm
"	6	100 pm
"	1	85 pm
Watchman	1	90 pm
"	1	60 pm

5. Uncompahgre Valley Project (Colorado)[1]
6. Boise Project (Idaho)
7. King Hill Project (Idaho)
8. Minidoka Project (Idaho)
9. Huntley Project (Montana)
10. Milk River Project (Montana)
11. Sun River Project (Montana)
12. Blackfeet Project (Indian Project) (Montana)
13. Flathead Project (Indian Project) (Montana)
14. Fort Peck Project (Indian Project) (Montana)
15. Lower Yellowstone Project (Montana-No. Dakota)
16. North Platte Project (Nebraska-Wyoming)
17. Truckee-Carson Project (Nevada)
18. Carlsbad Project (New Mexico)

[1] The outline given includes only such employees as are employed fairly regularly throughout the year. During the months that construction work is practicable and during the operating season, the forces of the projects are materially increased in the number of gate tenders, ditchriders, water distributors, mechanics and laborers, and of engineers, instrumentmen, surveymen, clerks, storekeepers, timekeepers, shop clerks and the like.

19. Hondo Project (New Mexico)
20. Rio Grande Project (New Mexico-Texas)
21. North Dakota Pumping Project (North Dakota)
22. Lawton Project (Oklahoma)
23. Umatilla Project (Oregon)
24. Klamath Project (Oregon-California)
25. Belle Fourche Project (South Dakota)
26. Strawberry Valley Project (Utah)
27. Okanogan Project (Washington)
28. Yakima Project (Washington)
29. Shoshone Project (Wyoming)

3. Legal Division-Chief Counsel

1. Office Proper of Chief Counsel		
Chief Counsel	1	$ 6,000
Private Secretary	1	1,320
2. Central Offices (Washington, D. C.)		
1. Law Section — Acting Chief Counsel		
Acting Chief Counsel	1	2,760
Legal Examiner	1	2,000
" "	1	1,680
" "	1	1,600
Stenographer	1	960
2. Land and General Section—Counsel		
Counsel	1	4,500
Legal examiner	1	2,280
" "	1	1,920
" "	1	1,560
" "	1	1,560
Draftsman	1	1,500
Stenographer	1	1,380
3. Field Establishment—Assistant Chief Counsel		
1. Office Proper of Assistant Chief Counsel (Denver, Colo.)		
Assistant Chief Counsel	1	2,400
Legal Examiner	1	1,620
Junior Engineer	1	1,320
Chief Clerk	1	1,080
2. District Offices		

1. Denver, Colorado—District Counsel		
District Counsel	1	2,400
" "	1	1,800
" "	1	2,700
" "	1	1,800
Stenographer	3	1,200
Messenger	1	420
2. Montrose, Colorado — District Counsel		
District Counsel	1	1,920
3. El Paso, Texas—District Counsel		
District Counsel	1	2,400
Stenographer	1	1,400
Stenographer and Law Clerk	1	1,260
4. Scottsbluff, Neb. — District Counsel		
District Counsel	1	2,820
Assistant District Counsel	1	2,040
5. Los Angeles, Cal.—District Counsel		
District Counsel	1	3,000
" "	1	2,580
" "	1	2,520
Assistant District Counsel	1	1,320
Stenographer	1	1,200
"	1	1,020
6. Provo, Utah—District Counsel		
District Counsel	1	1,800
7. Boise, Idaho — District Counsel		
District Counsel	1	2,940
Stenographer	1	1,260
8. North Yakima, Wash.—District Counsel		
District Counsel	1	1,800
Stenographer	1	1,200
9. Portland, Oregon—District Counsel		
District Counsel	1	6.50 pd
Stenographer	1	1,140
10. Helena, Montana—District Counsel		
District Counsel	1	2,760
Chief Clerk	1	1,500
Stenographer	1	1,080
4. Office of the Supervisor of Irrigation (Billings, Montana)		
Supervisor of Irrigation	1	21 pd
Chief Clerk and Secretary	1	2,100

APPENDIX 2

CLASSIFICATION OF ACTIVITIES

Explanatory Note

The Classifications of Activities have for their purpose to list and classify in all practicable detail the specific activities engaged in by the several services of the national government. Such statements are of value from a number of standpoints. They furnish, in the first place, the most effective showing that can be made in brief compass of the character of work performed by the service to which they relate. Secondly, they lay the basis for a system of accounting and reporting that will permit the showing of total expenditures classified according to activities. Finally, taken collectively, they make possible the preparation of a general or consolidated statement of the activities of the government as a whole. Such a statement will reveal in detail, not only what the government is doing, but the services in which the work is being performed. For example, one class of activities that would probably appear in such a classification is that of "scientific research." A subhead under this class would be "chemical research." Under this head would appear the specific lines of investigation under way and the services in which they were being prosecuted. It is hardly necessary to point out the value of such information in planning for future work and in considering the problem of the better distribution and coördination of the work of the government. The Institute contemplates attempting such a general listing and classification of the activities of the government upon the completion of the present series.

Classification of Activities

1. Survey and examination of irrigable areas
    1. Reconnaissance
    2. Preliminary Survey
    3. Examination of Reservoir Sites
    4. Detail surveys and preparation of topographic maps
2. Design of reclamation works
3. Construction of reclamation works (including hydro-electric and steam power plants, etc.)
    1. Construction by force employed by the Service
    2. Construction by contractor under supervision of Service
    3. Operation of messes, stores, hospitals, etc.
4. Determination of limit of area per entry
5. Operation and maintenance of irrigation works (including hydro-electric and steam power plants, etc.)
6. Operation and maintenance of coal mines, railroads, telephone, and transmission lines
7. Imposition and collection of charges (for construction, water-rights and power)
8. Dissemination of information to water users and prospective settlers
    1. In regard to terms and conditions of settlement on projects
    2. In regard to agricultural problems of arid and irrigated lands
9. Research into action of alkali on concrete.

APPENDIX 3

PUBLICATIONS

Regular Publications. The only publications regularly issued by the Reclamation Service are its annual report and the monthly periodical known as the "Reclamation Record."

Annual Report. This report gives general information regarding the work of the Service during the fiscal year to which it relates, giving a brief history of construction and operation of each project. In addition, the later reports contain an appendix largely devoted to statistical data. The fifteenth report contains a history of the construction of each project from the beginning of work to June 30, 1916. A limited number of the annual reports are distributed free by the Service. The reports are also sold by the Superintendent of Documents at prices varying from 20 to 30 cents for paper binding and from 80 cents to $1.25 for cloth.

Reclamation Record. The Reclamation Record is issued monthly and usually contains about 48 pages. It gives an account of the construction, operation, and maintenance work of the Service, and contains many illustrated articles of interest to the water users on the projects and to others having to do with irrigation matters. The Record is sent free to all water users on the projects and to a selected list of other individuals. To others the price is 50 cents a year, payable in advance. Subscriptions are received by the Reclamation Service.

Occasional Publications. From time to time the Service publishes pamphlets, books and maps incidental to its work. These are described below under the following heads:

1. Reports of Investigations.
2. Information for water users and for prospective settlers on Reclamation projects.
3. Manual of the Service.
4. Engineering Publications.
5. List of Publications.

Reports of Investigations in Coöperation with States. The Reclamation Service has made a number of investigations of proposed irrigation projects in coöperation with the states. It has published reports of its investigations in the case of the following projects:

California:

Iron Canyon project
Pit River Basin
Lower Pit River project

Oregon:
Deschutes project
Ochoco and Crooked River investigations
Silver Lake project
John Day project
Rogue River Valley and Willamette Valley projects
Malheur and Owyhee projects
Harney and Silver Creek projects
Warner Valley and White River projects

These reports include a discussion of the water supply, storage, stream flow, flood control, reservoirs, dams, canals and distribution systems, water power development, estimated costs, irrigable area, rights of way, alkali, seepage, drainage, crops and crop values. These reports are distributed free by the Service.

Information for Water Users and for Prospective Settlers on Reclamation Projects. The publications of this kind fall under two heads, those giving information relative to the terms and conditions of settlement on the projects and those treating of the agricultural problems encountered on arid and irrigated lands.

Under the first head may be listed:

1. General Reclamation Circular. This circular includes a compilation of all of the laws and regulations relating to the reclamation of arid lands by the United States, especially applying to Reclamation Homestead entries, and water right applicants and regulations thereunder. It does not contain the general homestead law, most of which also applies to Reclamation Homestead entries. This circular is distributed free by the Service.

2. Settlement Pamphlets. These pamphlets are intended to give specific information as to the local conditions on each of the reclamation projects, such as size of farms, climate, altitude, water supply, soils, cost of clearing lands, crops, markets, etc. A general illustrated pamphlet is issued covering all the projects and a separate pamphlet is also issued for each of the projects with few exceptions. These pamphlets are distributed free by the Service.

3. Topographic Maps of Irrigation Canals. These maps are sold by the Service at prices ranging from 50 cents to $2.00.

4. Organization of Water Users' Associations. This is a pamphlet issued by the Reclamation Service for the information of water users. It makes suggestions as to the articles of incorporation and form of organization. This pamphlet is distributed free by the Service.

Under the head of general information relative to the problems of farming on arid and irrigated lands, the Service has to date issued several pamphlets treating of such matters as the capital required by the irrigator, the prices, values and profits of irrigated lands, production cost and returns from farm animals, etc. These pamphlets are distributed free by the Service.

Manual of the Reclamation Service. This manual, which covers

the laws, rules, regulations, and practices of the Service, is published in loose-leaf form in two volumes, volume one relating to the administrative, engineering, legal and operation and maintenance work of the Service and volume two to the accounting procedure. Each volume of the manual is sold by the Service at $3.00 with the binder.

Engineering Publications. The Service has issued from time to time a variety of publications designed to make available to the engineering profession the technical data and practices developed by it in the course of its work. These publications may be listed under the following heads:

1. Hydraulic and Excavation Tables.
2. Tables for Reënforced Concrete.
3. Measurement of Irrigation Water.
4. Specimen Field Notes and Plats.
5. Special Drawings. (These drawings cover such topics as sluicing gates, types of cylinder dams, types of movable dam crest, etc.)
6. Standard Designs.
7. Standard Specifications.
8. Specifications and Drawings.
9. List of Engineering Articles.

The list of engineering articles is supplied free. All other engineering publications in the above list are sold by the Service at prices ranging from 10 cents to $1.00.

List of Publications. From time to time the Service has issued in pamphlet form a list of all the publications issued by it. The latest list is that published in August, 1916, and is supplied free by the Service. A revised list is in process of printing. (Jan. 1918).

APPENDIX 4

MAJOR EQUIPMENT FOR ALL PROJECTS ON JUNE 30, 1917

Air compressors	24	Graders, road	23
Automobiles	168	Electrical plants	14
Boats	43	Horses and mules	1185
Boilers	78	Hydraulic rams	13
Cableways	7	Locomotives, elec.	9
Cars, standard gage	221	" steam	26
" narrow gage	390	Motorcycles	40
" concrete	85	Motors, electric	121
Carts, dump	63	Pile drivers	28
" other	123	Plows	505
Concrete mixers	85	Pumps	346
Derricks, stiff leg	41	Rock crushers	15
" guy	31	Scrapers, fresno	902
Dredges	2	" slip	1270
Drills, diamond	9	" wheel	368
" well	8	Sleighs and sleds	68
" air and steam	138	Spring wagons & buggies	185
" electric	8	Sprinklers	3
Engines, gasoline	107	Steam shovels	12
" steam	79	Traction engines	11
Excavators, dragline	22	Wagons, dump	123
" other	10	" hvy. freight	262
Graders, electrical	28	" light freight	263
" elevating	7		

APPENDIX 5

LAWS

1902—**Act of June 17, 1902** (32 Stat., 388)—An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands. (The Reclamation Act)

That all moneys received from the sale and disposal of public lands in Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming,[1] beginning with the fiscal year ending June thirtieth, nineteen hundred and one, including the surplus of fees and commissions in excess of allowances to registers and receivers, and excepting the five per centum of the proceeds of the sales of public lands in the above States set aside by law for educational and other purposes, shall be, and the same are hereby, reserved, set aside, and appropriated as a special fund in the Treasury to be known as the "reclamation fund," to be used in the examination and survey for and the construction and maintenance of irrigation works for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the said States and Territories, and for the payment of all other expenditures provided for in this act: *Provided,* That in case the receipts from the sale and disposal of public lands other than those realized from the sale and disposal of lands referred to in this section are insufficient to meet the requirements for the support of agricultural colleges in the several States and Territories, under the act of August thirtieth, eighteen hundred and ninety, entitled "An act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and the mechanic arts, established under the provisions of an act of Congress approved July second, eighteen hundred and sixty-two," the deficiency, if any, in the sum necessary for the support of the said colleges shall be provided for from any moneys in the Treasury not otherwise appropriated.

Sec. 2. That the Secretary of the Interior is hereby authorized and directed to make examinations and surveys for, and to locate and construct, as herein provided, irrigation works for the storage, diversion, and development of waters, including artesian wells, and to report to Congress at the beginning of each regular session as to the results of such examinations and surveys, giving estimates of

[1] See below act of June 12, 1906, extending this act to the State of Texas.

cost of all contemplated works, the quantity and location of the lands which can be irrigated therefrom, and all facts relative to the practicability of each irrigation project; also the cost of works in process of construction as well as of those which have been completed.

Sec. 3. That the Secretary of the Interior shall, before giving the public notice provided for in section four of this act, withdraw from public entry the lands required for any irrigation works contemplated under the provisions of this act, and shall restore to public entry any of the lands so withdrawn when, in his judgment, such lands are not required for the purposes of this act; and the Secretary of the Interior is hereby authorized, at or immediately prior to the time of beginning the surveys for any contemplated irrigation works, to withdraw from entry, except under the homestead laws, any public lands believed to be susceptible of irrigation from said works: *Provided,* That all lands entered and entries made under the homestead laws within areas so withdrawn during such withdrawal shall be subject to all the provisions, limitations, charges, terms, and conditions of this act; that said surveys shall be prosecuted diligently to completion, and upon the completion thereof, and of the necessary maps, plans and estimates of cost, the Secretary of the Interior shall determine whether or not said project is practicable and advisable, and if determined to be impracticable or unadvisable he shall thereupon restore said lands to entry; that public lands which it is proposed to irrigate by means of any contemplated works shall be subject to entry only under the provisions of the homestead laws in tracts of not less than forty[1] nor more than one hundred and sixty acres, and shall be subject to the limitations, charges, terms, and conditions herein provided: *Provided,* That the commutation provisions of the homestead laws shall not apply to entries made under this act.

Sec. 4. That upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, in such portions or sections as it may be practicable to construct and complete as parts of the whole project, providing the necessary funds for such portions or sections are available in the reclamation fund, and thereupon he shall give public notice of the lands irrigable under such project, and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also of the charges which shall be made per acre upon the said entries, and upon lands in private ownership which may be irrigated by the waters of the said irrigation project, and the number of annual installments, not exceeding ten, in which such charges shall be paid and the time when such payments shall commence. The said charges shall be determined with a view of returning to the reclamation fund the estimated cost of construction of the project, and shall be apportioned equitably: *Provided,* That in all construction work eight

[1] See below act of June 27, 1906, Sec 1, authorizing Secretary of the Interior to establish a minimum of ten acres.

hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

Sec. 5. That the entryman upon lands to be irrigated by such works shall, in addition to compliance with the homestead laws, reclaim at least one-half of the total irrigable area of his entry for agricultural purposes, and before receiving patent for the lands covered by his entry shall pay to the Government the charges apportioned against such tract, as provided in section four. No right to the use of water for land in private ownership shall be sold for a tract exceeding one hundred and sixty acres to any one landowner, and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land, or occupant thereof residing in the neighborhood of said land, and no such right shall permanently attach until all payments therefor are made. The annual installments shall be paid to the receiver of the local land office of the district in which the land is situated, and a failure to make any two payments when due shall render the entry subject to cancellation, with the forfeiture of all rights under this act, as well as of any moneys already paid thereon. All moneys received from the above sources shall be paid into the reclamation fund. Registers and receivers shall be allowed the usual commissions on all moneys paid for lands entered under this act.

Sec. 6. That the Secretary of the Interior is hereby authorized and directed to use the reclamation fund for the operation and maintenance of all reservoirs and irrigation works constructed under the provisions of this act: *Provided,* That when the payments required by this act are made for the major portion of the lands irrigated from the waters of any of the works herein provided for, then the management and operation of such irrigation works shall pass to the owners of the lands irrigated thereby, to be maintained at their expense under such form of organization and under such rules and regulations as may be acceptable to the Secretary of the Interior: *Provided,* That the title to and the management and operation of the reservoirs and the works necessary for their protection and operation shall remain in the Government until otherwise provided by Congress.

Sec. 7. That where in carrying out the provisions of this act it becomes necessary to acquire any rights or property, the Secretary of the Interior is hereby authorized to acquire the same for the United States by purchase or by condemnation under judicial process, and to pay from the reclamation fund the sums which may be needed for that purpose, and it shall be the duty of the Attorney General of the United States upon every application of the Secretary of the Interior, under this act, to cause proceedings to be commenced for condemnation within thirty days from the receipt of the application at the Department of Justice.

Sec. 8. That nothing in this act shall be construed as affecting or intended to affect or to in any way interfere with the laws of any State or Territory relating to the control, appropriation, use, or distribution of water used in irrigation, or any vested right acquired thereunder, and the Secretary of the Interior, in carrying out the

provisions of this act, shall proceed in conformity with such laws, and nothing herein shall in any way affect any right of any State or of the Federal Government or of any landowner, appropriator, or user of water in, to, or from any interstate stream or the waters thereof: *Provided,* That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated and beneficial use shall be the basis, the measure, and the limit of the right.

Sec. 9. [Repealed by section 6, act of June 25, 1910, 36 Stat., 835.] [1]

Sec. 10. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full force and effect.

1905—**Act of February 8, 1905** (33 Stat., 706)—An act authorizing the use of earth, stone and timber on the public lands and forest reserves of the United States in the construction of works under the national irrigation law.

That in carrying out the provisions of the national irrigation law, approved June seventeenth, nineteen hundred and two, and in constructing works thereunder, the Secretary of the Interior is hereby authorized to use and to permit the use by those engaged in the construction of works under said law, under rules and regulations to be prescribed by him, such earth, stone, and timber from the public lands of the United States as may be required in the construction of such works, and the Secretary of Agriculture is hereby authorized to permit the use of earth, stone, and timber from the forest reserves of the United States for the same purpose, under rules and regulations to be prescribed by him.

1905—**Act of March 3, 1905** (33 Stat., 1032)—An act to provide for the covering into the reclamation fund certain proceeds of sales of property purchased by the reclamation fund.

That there shall be covered into the reclamation fund established

[1] The repealed section reads as follows:

"That it is hereby declared to be the duty of the Secretary of the Interior in carrying out the provisions of this act, so far as the same may be practicable and subject to the existence of feasible irrigation projects, to expend the major portion of the funds arising from the sale of public lands within each State and Territory hereinbefore named for the benefit of arid and semi-arid lands within the limits of such State or Territory: *Provided,* that the Secretary may temporarily use such particular State or Territory hereinbefore named as he may deem advisable, but when so used the excess shall be restored to the fund as soon as practicable, to the end that ultimately, and in any event, within each ten-year period after the passage of this act, the expenditures for the benefit of the said States and Territories shall be equalized according to the proportions and subject to the conditions as to practicability and feasibility aforesaid."

under the act of June seventeenth, nineteen hundred and two, known as the reclamation act, the proceeds of the sales of material utilized for temporary work and structures in connection with the operations under the said act, as well as of the sales of all other condemned property which had been purchased under the provisions thereof, and also any moneys refunded in connection with the operations under said reclamation act.

1906—Act of April 16, 1906 (34 Stat., 116)—An act providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation act of June 17, 1902, and for other purposes.

That the Secretary of the Interior may withdraw from public entry any lands needed for town-site purposes in connection with irrigation projects under the reclamation act of June seventeenth, nineteen hundred and two, not exceeding one hundred and sixty acres in each case, and survey and subdivide the same into town lots, with appropriate reservations for public purposes.

Sec. 2. That the lots so surveyed shall be appraised under the direction of the Secretary of the Interior and sold under his direction at not less than their appraised value at public auction to the highest bidders, from time to time, for cash, and the lots offered for sale and not disposed of may afterwards be sold at not less than the appraised value under such regulations as the Secretary of the Interior may prescribe. Reclamation funds may be used to defray the necessary expenses of appraisement and sale, and the proceeds of such sales shall be covered into the reclamation fund.

Sec. 3. That the public reservations in such town sites shall be improved and maintained by the town authorities at the expense of the town; and upon the organization thereof as municipal corporations the said reservations shall be conveyed to such corporations by the Secretary of the Interior, subject to the condition that they shall be used forever for public purposes.

Sec. 4. That the Secretary of the Interior shall, in accordance with the provisions of the reclamation act, provide for water rights in amount he may deem necessary for the towns established as herein provided, and may enter into contract with the proper authorities of such towns, and other towns or cities on or in the immediate vicinity of irrigation projects, which shall have a water right from the same source as that of said project for the delivery of such water supply to some convenient point, and for the payment into the reclamation fund of charges for the same to be paid by such towns or cities, which charges shall not be less nor upon terms more favorable than those fixed by the Secretary of the Interior for the irrigation project from which the water is taken.

Sec. 5. That whenever a development of power is necessary for the irrigation of lands under any project undertaken under the said reclamation act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or power privi-

lege, and the moneys derived from such leases shall be covered into the reclamation fund and be placed to the credit of the project from which such power is derived: *Provided,* That no lease shall be made of such surplus power or power privilege as will impair the efficiency of the irrigation project.

1906—**Act of June 12, 1906** (34 Stat., 259)—An act to extend the irrigation act to the State of Texas.

That the provisions of the act entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," approved June seventeenth, nineteen hundred and two, be, and the same are hereby, extended so as to include and apply to the State of Texas.

1906—**Act of June 27, 1906** (34 Stat., 519)—An act providing for the subdivision of lands entered under the reclamation act, and for other purposes.

That whenever, in the opinion of the Secretary of the Interior, by reason of market conditions and the special fitness of the soil and climate for the growth of fruit and garden produce, a lesser area than forty acres may be sufficient for the support of a family on lands to be irrigated under the provisions of the act of June seventeenth, nineteen hundred and two, known as the reclamation act, he may fix a lesser area than forty acres as the minimum entry and may establish farm units of not less than ten nor more than one hundred and sixty acres. That wherever it may be necessary, for the purpose of accurate description, to further subdivide lands to be irrigated under the provisions of said reclamation act, the Secretary of the Interior may cause subdivision surveys to be made by the officers of the Reclamation Service, which subdivisions shall be rectangular in form, except in cases where irregular subdivisions may be necessary in order to provide for practicable and economical irrigation. Such subdivision surveys shall be noted upon the tract books in the General Land Office, and they shall be paid for from the reclamation fund: *Provided,* That an entryman may elect to enter under said reclamation act a lesser area than the minimum limit in any State or Territory.

1908—**Act of Apr. 30, 1908** (35 Stat., 70)—An act making appropriations for the current and contingent expenses of the Indian Department, for fulfilling treaty stipulations with various Indian tribes, and for other purposes, for the fiscal year ending June 30, 1909.

That in carrying out any irrigation project which may be undertaken under the provisions of the act of June seventeenth, nineteen hundred and two (Thirty-second Statutes, page three hundred and eighty-eight), known as the reclamation act, and which may make possible, and provide for, in connection with the reclamation of other lands, the irrigation of all or any part of the irrigable lands hereto-

fore included in allotments made to Indians under the fourth section of the general allotment act, the Secretary of the Interior be, and he hereby is, authorized to make such arrangement and agreement in reference thereto as said Secretary deems for the best interest of the Indians: *Provided,* That no lien or charge for construction, operation, or maintenance shall thereby be created against any such reserved lands: *And provided further,* That to meet the necessary cost of carrying out this legislation the Secretary of the Interior is authorized to expend, out of the sum appropriated in this act for irrigation, an amount not exceeding $13,000.

1910—**Act of June 25, 1910** (36 Stat., 835)—An act to authorize advances to the "reclamation fund," and for the issue and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes.

That to enable the Secretary of the Interior to complete Government reclamation projects heretofore begun, the Secretary of the Treasury is authorized, upon request of the Secretary of the Interior, to transfer from time to time to the credit of the reclamation fund created by the act entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," approved June seventeenth, nineteen hundred and two, such sum or sums, not exceeding in the aggregate $20,000,000, as the Secretary of the Interior may deem necessary to complete the said reclamation projects, and such extensions thereof as he may deem proper and necessary to the successful and profitable operation and maintenance thereof or to protect water rights pertaining thereto claimed by the United States, provided the same shall be approved by the President of the United States; and such sum or sums as may be required to comply with the foregoing authority are hereby appropriated out of any money in the Treasury not otherwise appropriated: *Provided,* That the sums hereby authorized to be transferred to the reclamation fund shall be so transferred only as such sums shall be actually needed to meet payments for work performed under existing law: *And provided further,* That all sums so transferred shall be reimbursed to the Treasury from the reclamation fund, as hereinafter provided: *And provided further,* That no part of this appropriation shall be expended upon any existing project until it shall have been examined and reported upon by a board of engineer officers of the Army, designated by the President of the United States, and until it shall be approved by the President as feasible and practicable and worthy of such expenditure; nor shall any portion of this appropriation be expended upon any new project.

Sec. 2. That for the purpose of providing the Treasury with funds for such advances to the reclamation fund, the Secretary of the Treasury is authorized to issue certificates of indebtedness of the United States in such form as he may prescribe and in denominations of $50, or multiples of that sum; said certificates to be redeemable at the option of the United States at any time after three years from the date of their issue and to be payable five years after such date,

and to bear interest, payable semiannually, at not exceeding three per centum per annum; the principal and interest to be payable in gold coin of the United States. The certificates of indebtedness herein authorized may be disposed of by the Secretary of the Treasury at not less than par, under such rules and regulations as he may prescribe, giving all citizens of the United States an equal opportunity to subscribe therefor, but no commission shall be allowed and the aggregate issue of such certificates shall not exceed the amount of all advances made to said reclamation fund, and in no event shall the same exceed the sum of $20,000,000. The certificates of indebtedness herein authorized shall be exempt from taxes or duties of the United States as well as from taxation in any form by or under State, municipal, or local authority; and a sum not exceeding one-tenth of one per centum of the amount of the certificates of indebtedness issued under this act is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to pay the expense of preparing, advertising, and issuing the same.

Sec. 3. That beginning five years after the date of the first advance to the reclamation fund under this act, fifty per centum of the annual receipts of the reclamation fund shall be paid into the general fund of the Treasury of the United States until payments so made shall equal the aggregate amount of advances made by the Treasury to said reclamation fund, together with interest paid on the certificates of indebtedness issued under this act and any expense incident to preparing, advertising, and issuing the same.

Sec. 4. That all money placed to the credit of the reclamation fund in pursuance of this act shall be devoted exclusively to the completion of work on reclamation projects heretofore begun as hereinbefore provided, and the same shall be included with all other expenses in future estimates of construction, operation, or maintenance, and hereafter no irrigation project contemplated by said act of June seventeenth, nineteen hundred and two, shall be begun unless and until the same shall have been recommended by the Secretary of the Interior and approved by the direct order of the President of the United States.

Sec. 5. [Amended by act of Feb. 18, 1911 (36 Stat. L., 917), and then by act of Aug. 13, 1914, Sec. 10, below] [1]

[1] The original section read as follows: "That no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage and fixed the water charges and the date when the water can be applied and made public announcement of the same."

The act of Feb. 18, 1911 added the following proviso: *"Provided,* that where entries made prior to June twenty-fifth, nineteen hundred and ten, have been or may be relinquished in whole or in part, the lands so relinquished shall be subject to settlement and entry under the homestead law as amended by an Act entitled 'An act appropriating the receipts from the sale and disposal of the public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands,' approved June seventeenth, nineteen hundred and two (Thirty-second Statutes at Large, page three hundred and eighty-eight)."

Sec. 6. That section nine of said act of Congress, approved June seventeenth, nineteen hundred and two, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," is hereby repealed.

1911—**Act of Feb. 2, 1911** (36 Stat., 895)—An act to provide for the sale of lands acquired under the provisions of the reclamation act and which are not needed for the purposes of that act.

That whenever in the opinion of the Secretary of the Interior any lands which have been acquired under the provisions of the act of June seventeenth, nineteen hundred and two (Thirty-second Statutes, page three hundred and eighty-eight), commonly called the "reclamation act," or under the provisions of any act amendatory thereof or supplementary thereto, for any irrigation works contemplated by said reclamation act are not needed for the purposes for which they were acquired, said Secretary of the Interior may cause said lands, together with the improvements thereon, to be appraised by three disinterested persons, to be appointed by him, and thereafter to sell the same for not less than the appraised value at public auction to the highest bidder, after giving public notice of the time and place of sale by posting upon the land and by publication for not less than thirty days in a newspaper of general circulation in the vicinity of the land.

Sec. 2. That upon payment of the purchase price, the Secretary of the Interior is authorized by appropriate deed to convey all the right, title, and interest of the United States of, in, and to said lands to the purchaser at said sale, subject, however, to such reservations, limitations, or conditions as said Secretary may deem proper: *Provided,* That not over one hundred and sixty acres shall be sold to any one person.

Sec. 3. That the moneys derived from the sale of such lands shall be covered into the reclamation fund and be placed to the credit of the project for which such lands had been acquired.

1911—**Act of Feb. 13, 1911** (36 Stat., 902)—An act to authorize the Secretary of the Interior to withdraw public notices issued under section 4 of the reclamation act, and for other purposes.[1]

That the Secretary of the Interior may, in his discretion, withdraw any public notice heretofore issued under section four of the reclamation act of June seventeenth, nineteen hundred and two, and he may agree to such modification of water-right applications heretofore duly filed or contracts with water users' associations and others, entered into prior to the passage of this act, as he may deem advisable, or he may consent to the abrogation of such water-right applications and contracts, and proceed in all respects as if no such notice had been given.

[1] Popularly known as the Curtis Act, being so named for Senator Charles Curtis, of Kansas.

1911—Act of Feb. 18, 1911 (36 Stat., 917)—An act to amend section 5 of the act of Congress of June 25, 1910, entitled "An act to authorize advances to the 'reclamation fund,' and for the issue and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes."

That section five of an act entitled "An act to authorize advances to the 'reclamation fund,' and for the issue and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes," approved June twenty-fifth, nineteen hundred and ten (Thirty-six Statutes at Large, page eight hundred and thirty-five), be, and the same hereby is, amended as follows:

"Sec. 5. That no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage and fixed the water charges and the date when the water can be applied and make public announcement of the same: *Provided,* That where entries made prior to June twenty-fifth, nineteen hundred and ten, have been or may be relinquished in whole or in part, the lands so relinquished shall be subject to settlement and entry under the homestead law as amended by an Act entitled 'An act appropriating the receipts from the sale and disposal of the public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands,' approved June seventeenth, nineteen hundred and two." (Thirty-second Statutes at Large, page three hundred and eighty-eight).

1911—Act of Feb. 21, 1911 (36 Stat., 925)—An act to authorize the Government to contract for impounding, storing, and carriage of water, and to coöperate in the construction and use of reservoirs and canals under reclamation projects, and for other purposes.[1]

That whenever in carrying out the provisions of the reclamation law, storage or carrying capacity has been or may be provided in excess of the requirements of the lands to be irrigated under any project, the Secretary of the Interior, preserving a first right to lands and entrymen under the project, is hereby authorized, upon such terms as he may determine to be just and equitable, to contract for the impounding, storage, and carriage of water to an extent not exceeding such excess capacity with irrigation systems operating under the act of August eighteenth, eighteen hundred and ninety-four, known as the Carey Act, and individuals, corporations, associations, and irrigation districts organized for or engaged in furnishing or in distributing water for irrigation. Water so impounded, stored, or carried under any such contract shall be for the purpose of distribution to individual water users by the party with whom the contract is made: *Provided,* however, That waters so impounded, stored, or carried shall not be used otherwise than as prescribed by law as to lands held in private ownership within Government re-

[1] Popularly known as the Warren Act, being so named for Senator Francis E. Warren, of Wyoming.

clamation projects. In fixing the charges under any such contract for impounding, storing, or carrying water for any irrigation system, corporation, association, district, or individual, as herein provided, the Secetary shall take into consideration the cost of construction and maintenance of the reservoir by which such water is to be impounded or stored and the canal by which it is to be carried, and such charges shall be just and equitable, as to water users under the Government project. No irrigation system, district, association, corporation, or individual so contracting shall make any charge for the storage, carriage, or delivery of such water in excess of the charge paid to the United States except to such extent as may be reasonably necessary to cover cost of carriage and delivery of such water through their works.

Sec. 2. That in carrying out the provisions of said reclamation act and acts amendatory thereof or supplementary thereto, the Secretary of the Interior is authorized, upon such terms as may be agreed upon, to coöperate with irrigation districts, water users' associations, corporations, entrymen or water users for the construction or use of such reservoirs, canals, or ditches as may be advantageously used by the Government and irrigation districts, water users' associations, corporations, entrymen or water users for impounding, delivering, and carrying water for irrigation purposes: *Provided,* That the title to and management of the works so constructed shall be subject to the provisions of section six of said act: *Provided further,* That water shall not be furnished from any such reservoir or delivered through any such canal or ditch to any one landowner in excess of an amount sufficient to irrigate one hundred and sixty acres: *Provided,* That nothing contained in this act shall be held or construed as enlarging or attempting to enlarge the right of the United States, under existing law, to control the waters of any stream in any State.

Sec. 3. That the moneys received in pursuance of such contracts shall be covered into the reclamation fund and be available for use under the terms of the reclamation act and the acts amendatory thereof or supplementary thereto.

1911—**Act of Feb. 24, 1911** (36 Stat., 930)—An act to amend an act entitled "An act providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation act of June 17, 1902, and for other purposes," approved April 17, 1906.

That section five of an act entitled "An act providing for the withdrawal from public entry of lands needed for town-site purposes in connection with irrigation projects under the reclamation act of June seventeenth, nineteen hundred and two, and for other purposes," approved April sixteenth, nineteen hundred and six, be amended so as to read as follows:

"Sec. 5. That whenever a development of power is necessary for the irrigation of lands, under any project undertaken under the said

reclamation act, or an opportunity is afforded for the development of power under any such project, the Secretary of the Interior is authorized to lease for a period not exceeding ten years, giving preference to municipal purposes, any surplus power or power privilege, and the money derived from such leases shall be covered into the reclamation fund and be placed to the credit of the project from which such power is derived: *Provided,* That no lease shall be made of such surplus power or power privileges as will impair the efficiency of the irrigation project: *Provided further,* That the Secretary of the Interior is authorized, in his discretion, to make such a lease in connection with Rio Grande project in Texas and New Mexico for a longer period not exceeding fifty years, with the approval of the water users' association or associations under any such project, organized in conformity with the rules and regulations prescribed by the Secretary of the Interior in pursuance of section six of the reclamation act approved June seventeenth, nineteen hundred and two."

1912—**Act of Apr. 30, 1912** (37 Stat., 105)—An act for the relief of homestead entrymen under the reclamation projects in the United States.

That no qualified entryman who prior to June twenty-fifth, nineteen hundred and ten, made bona fide entry upon lands proposed to be irrigated under the provisions of the act of June seventeenth, nineteen hundred and two, the national reclamation law, and who established residence in good faith upon the lands entered by him, shall be subject to contest for failure to maintain residence or make improvements upon his land prior to the time when water is available for the irrigation of the lands embraced in his entry, but all such entrymen shall, within ninety days after the issuance of the public notice required by section four of the reclamation act, fixing the date when water will be available for irrigation, file in the local land office a water-tight application for the irrigable lands embraced in his entry, in conformity with the public notice and approved farm-unit plat for the township in which his entry lies, and shall also file an affidavit that he has reëstablished his residence on the land with the intention of maintaining the same for a period sufficient to enable him to make final proof: *Provided,* That no such entryman shall be entitled to have counted as part of the required period of residence any period of time during which he was not actually upon the said land prior to the date of the notice aforesaid, and no application for the entry of said lands shall be received until after the expiration of the ninety days after the issuance of notice within which the entryman is hereby required to reëstablish his residence and apply for water right.

1912—**Act of Aug. 9, 1912** (37 Stat., 265)—An act providing for patents on reclamation entries, and for other purposes.

That any homestead entryman under the act of June seventeenth, nineteen hundred and two, known as the reclamation act, including

entrymen on ceded Indian lands, may, at any time after having complied with the provisions of law applicable to such lands as to residence, reclamation, and cultivation, submit proof of such residence, reclamation, and cultivation, which proof, if found regular and satisfactory, shall entitle the entryman to a patent, and all purchasers of water-right certificates on reclamation projects shall be entitled to a final water-right certificate upon proof of the cultivation and reclamation of the land to which the certificate applies, to the extent required by the reclamation act for homestead entrymen: *Provided,* That no such patent or certificate shall issue until all sums due the United States on account of such land or water-right at the time of issuance of patent or certificate have been paid.[1]

Sec. 2. That every patent and water-right certificate issued under this act shall expressly reserve to the United States a prior lien on the land patented or for which water right is certified, together with all water rights appurtenant or belonging thereto, superior to all other liens, claims, or demands whatsoever for the payment of all sums due or to become due to the United States or its successors in control of the irrigation project in connection with such lands and water rights.

Upon default of payment of any amount so due title to the land shall pass to the United States free of all encumbrance, subject to the right of the defaulting debtor or any mortgagee, lien holder, judgment debtor, or subsequent purchaser to redeem the land within one year after the notice of such default shall have been given by payment of all moneys due, with eight per centum interest and cost. And the United States, at its option, acting through the Secretary of the Interior, may cause land to be sold at any time after such failure to redeem, and from the proceeds of the sale there shall be paid into the reclamation fund all moneys due, with interest as herein provided, and costs. The balance of the proceeds, if any, shall be the property of the defaulting debtor or his assignee: *Provided,* That in case of sale after failure to redeem under this section the United States shall be authorized to bid in such land at not more than the amount in default, including interest and costs.

Sec. 3. That upon full and final payment being made of all amounts due on account of the building and betterment charges to the United States or its successors in control of the project, the United States or its successors, as the case may be, shall issue upon request a certificate certifying that payment of the building and betterment charges in full has been made and that the lien upon the land has been so far satisfied and is no longer of any force or effect except the lien for annual charges for operation and maintenance: *Provided,* That no person shall at any one time or in any manner, except as hereinafter otherwise provided, acquire, own, or hold

[1] This proviso was amended by Act of Feb. 15, 1917, below, to read: "*Provided,* That no such patent or final water-right certificate shall issue until after the payment of all sums due the United States on account of such land or water right at the time of the submission of proof entitling the homestead or desert-land entryman to such patent or the purchaser to such final water-right certificate."

irrigable land for which entry or water-right application shall have been made under the said reclamation act of June seventeenth, nineteen hundred and two, and acts supplementary thereto and amendatory thereof, before final payment in full of all installments of building and betterment charges shall have been made on account of such land in excess of one farm unit as fixed by the Secretary of the Interior as the limit of area per entry of public land or per single ownership of private land for which a water right may be purchased respectively, nor in any case in excess of one hundred and sixty acres, nor shall water be furnished under said acts nor a water right sold or recognized for such excess; but any such excess land acquired at any time in good faith by descent, by will, or by foreclosure of any lien may be held for two years and no longer after its acquisition; and every excess holding prohibited as aforesaid shall be forfeited to the United States by proceedings instituted by the Attorney General for that purpose in any court of competent jurisdiction; and this proviso shall be recited in every patent and water-right certificate issued by the United States under the provisions of this act.

Sec. 4. That the Secretary of the Interior is hereby authorized to designate such bonded fiscal agents or officers of the Reclamation Service as he may deem advisable on each reclamation project to whom shall be paid all sums due on reclamation entries or water rights, and the officials so designated shall keep a record for the information of the public of the sums paid and the amount due at any time on account of any entry made or water right purchased under the reclamation act; and the Secretary of the Interior shall make provision for furnishing copies of duly authenticated records of entries upon payment of reasonable fees, which copies shall be admissible in evidence, as are copies authenticated under section eight hundred and eighty-eight of the Revised Statutes.

1914—**Act of Aug. 13, 1914** (38 Stat., 686)—An act extending the period of payment under reclamation projects, and for other purposes. (Reclamation Extension Act.)

That any person whose lands hereafter become subject to the terms and conditions of the act approved June seventeenth, nineteen hundred and two, entitled "An act appropriating the receipts from the sale and disposal of public lands in certain States and Territories to the construction of irrigation works for the reclamation of arid lands," and acts amendatory thereof or supplementary thereto, hereafter to be referred to as the reclamation law, and any person who hereafter makes entry thereunder shall at the time of making water-right application or entry, as the case may be, pay into the reclamation fund five per centum of the construction charge fixed for his land as an initial installment, and shall pay the balance of said charge in fifteen annual installments, the first five of which shall each be five per centum of the construction charge and the remainder shall each be seven per centum until the whole amount shall have been paid. The first of the annual installments shall

become due and payable on December first of the fifth calendar year after the initial installment: *Provided,* That any water right applicant or entryman may, if he so elects, pay the whole or any part of the construction charges owing by him within any shorter period: *Provided further,* That entry may be made whenever water is available, as announced by the Secretary of the Interior, and the initial payment be made when the charge per acre is established.

Sec. 2. That any person whose land or entry has heretofore become subject to the terms and conditions of the reclamation law shall pay the construction charge, or the portion of the construction charge remaining unpaid, in twenty annual installments, the first of which shall become due and payable on December first of the year in which the public notice affecting his land is issued under this act, and subsequent installments on December first of each year thereafter. The first four of such installments shall each be two per centum, the next two installments shall each be four per centum, and the next fourteen each six per centum of the total construction charge, or the portion of the construction charge unpaid at the beginning of such installments.

Sec. 3. That if any water-right applicant or entryman shall fail to pay any installment of his construction charges when due, there shall be added to the amount unpaid a penalty of one per centum thereof, and there shall be added a like penalty of one per centum of the amount unpaid on the first day of each month thereafter so long as such default shall continue. If any such applicant or entryman shall be one year in default in the payment of any installment of the construction charges and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such default: *Provided,* That if the Secretary of the Interior shall so elect, he may cause suit or action to be brought for the recovery of the amount in default and penalties; but if suit or action be brought, the right to declare a cancellation and forfeiture shall be suspended pending such suit or action.

Sec. 4. That no increase in the construction charges shall hereafter be made, after the same have been fixed by public notice, except by agreement between the Secretary of the Interior and a majority of the water-right applicants and entrymen to be affected by such increase, whereupon all water-right applicants and entrymen in the area proposed to be affected by the increased charge shall become subject thereto. Such increased charge shall be added to the construction charge and payment thereof distributed over the remaining unpaid installments of construction charges: *Provided,* That the Secretary of the Interior, in his discretion, may agree that such increased construction charge shall be paid in additional annual installments, each of which shall be at least equal to the amount of the largest installment as fixed for the project by the public notice theretofore issued. And such additional installments of the increased

construction charge, as so agreed upon, shall become due and payable on December first of each year subsequent to the year when the final installment of the construction charge under such public notice is due and payable: *Provided further,* That all such increased construction charges shall be subject to the same conditions, penalties, and suit or action as provided in section three of this act.

Sec. 5. That in addition to the construction charge, every water-right applicant, entryman, or land owner under or upon a reclamation project shall also pay, whenever water service is available for the irrigation of his land, an operation and maintenance charge based upon the total cost of operation and maintenance of the project, or each separate unit thereof, and such charge shall be made for each acre-foot of water delivered; but each acre of irrigable land, whether irrigated or not, shall be charged with a minimum operation and maintenance charge based upon the charge for delivery of not less than one acre-foot of water: *Provided,* That whenever any legally organized water users' association or irrigation district shall so request, the Secretary of the Interior is hereby authorized, in his discretion, to transfer to such water users' association or irrigation district the care, operation, and maintenance of all or any part of the project works, subject to such rules and regulations as he may prescribe. If the total amount of operation and maintenance charges and penalties collected for any one irrigation season on any project shall exceed the cost of operation and maintenance of the project during that irrigation season, the balance shall be applied to a reduction of the charge on the project for the next irrigation season, and any deficit incurred may likewise be added to the charge for the next irrigation season.

Sec. 6. That all operation and maintenance charges shall become due and payable on the date fixed for each project by the Secretary of the Interior, and if such charge is paid on or before the date when due there shall be a discount of five per centum of such charge; but if such charge is unpaid on the first day of the third calendar month thereafter, a penalty of one per centum of the amount unpaid shall be added thereto, and thereafter an additional penalty of one per centum of the amount unpaid shall be added on the first day of each calendar month of such charge and penalties shall remain unpaid, and no water shall be delivered to the lands of any water-right applicant or entryman who shall be in arrears for more than one calendar year for the payment of any charge for operation and maintenance or any annual construction charge and penalties. If any water-right applicant or entryman shall be one year in arrears in the payment of any charge for operation and maintenance and penalties, or any part thereof, his water-right application, and if he be a homestead entryman his entry also, shall be subject to cancellation, and all payments made by him forfeited to the reclamation fund, but no homestead entry shall be subject to contest because of such arrears. In the discretion of the Secretary of the Interior suit or action may be brought for the amounts in default and penalties in like manner as provided in section three of this act.

Sec. 7. That the Secretary of the Interior is hereby authorized, in his discretion, to designate and appoint, under such rules and regulations as he may prescribe, the legally organized water users' association or irrigation district, under any reclamation project, as the fiscal agent of the United States to collect the annual payments on the construction charge of the project and the annual charges for operation and maintenance and all penalties: *Provided,* That no water-right applicant or entryman shall be entitled to credit for any payment thus made until the same shall have been paid over to an officer designated by the Secretary of the Interior to receive the same.

Sec. 8. That the Secretary of the Interior is hereby authorized to make general rules and regulations governing the use of water in the irrigation of the lands within any project, and may require the reclamation for agricultural purposes and the cultivation of one-fourth the irrigable area under each water-right application or entry within three full irrigation seasons after the filing of water-right application or entry, and the reclamation for agricultural purposes and the cultivation of one-half the irrigable area within five full irrigation seasons after the filing of the water-right application or entry, and shall provide for continued compliance with such requirements. Failure on the part of any water-right applicant or entryman to comply with such requirements shall render his application or entry subject to cancellation.

Sec. 9. That in all cases where application for water right for lands in private ownership or lands held under entries not subject to the reclamation law shall not be made within one year after the passage of this act, or within one year after notice issued in pursuance of section four of the reclamation act, in cases where such notice has not heretofore been issued, the construction charges for such land shall be increased five per centum each year until such application is made and an initial installment is paid.

Sec. 10. That the act of Congress approved February eighteenth, nineteen hundred and eleven, entitled "An act to amend section five of the act of Congress of June twenty-fifth, nineteen hundred and ten, entitled 'An act to authorize advances to the reclamation fund and for the issuance and disposal of certificates of indebtedness in reimbursement therefor, and for other purposes,'" be, and the same hereby is, amended so as to read as follows:

"Sec. 5. That no entry shall be hereafter made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior shall have established the unit of acreage per entry, and water is ready to be delivered for the land in such unit or some part thereof and such fact has been announced by the Secretary of the Interior: *Provided,* That where entries made prior to June twenty-fifth, nineteen hundred and ten, have been or may be relinquished, in whole or in part, the lands so relinquished shall be subject to settlement and entry under the reclamation law."

Sec. 11. That whenever water is available and it is impracticable to

apportion operation and maintenance charges as provided in section five of this act, the Secretary of the Interior may, prior to giving public notice of the construction charge per acre upon land under any project, furnish water to any entryman or private landowner thereunder until such notice is given, making a reasonable charge therefor, and such charges shall be subject to the same penalties and to the provisions for cancellation and collection as herein provided for other operation and maintenance charges.

Sec. 12. That before any contract is let or work begun for the construction of any reclamation project hereafter adopted the Secretary of the Interior shall require the owners of private lands thereunder to agree to dispose of all lands in excess of the area which he shall deem sufficient for the support of a family upon the land in question, upon such terms and at not to exceed such price as the Secretary of the Interior may designate; and if any landowner shall refuse to agree to the requirements fixed by the Secretary of the Interior, his land shall not be included within the projects if adopted for construction.

Sec. 13. That all entries under reclamation projects containing more than one farm unit shall be reduced in area and conformed to a single farm unit within two years after making proof of residence, improvement, and cultivation, or within two years after the issuance of a farm-unit plat for the project, if the same issues subsequent to the making of such proof: *Provided,* That such proof is made within four years from the date as announced by the Secretary of the Interior that water is available for delivery for the land. Any entryman failing within the period herein provided to dispose of the excess of his entry above one farm unit, in the manner provided by law, and to conform his entry to a single farm unit shall render his entry subject to cancellation as to the excess above one farm unit: *Provided,* That upon compliance with the provisions of law such entryman shall be entitled to receive a patent for that part of his entry which conforms to one farm unit as established for the project: *Provided further,* That no person shall hold by assignment more than one farm unit prior to final payment of all charges for all the land held by him subject to the reclamation law, except operation and maintenance charges not then due.

Sec. 14. [Amended by Act of July 26, 1916, below] [1]

Sec. 15. That the Secretary of the Interior is hereby authorized to perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this act into full force and effect.

Sec. 16. That from and after July first, nineteen hundred and fifteen, expenditures shall not be made for carrying out the purposes

[1] The original section read as follows: That any person whose land or entry has heretofore become subject to the reclamation law, who desires to secure the benefits of the extension of the period of payments provided by this act, shall, within six months after the issuance of the first public notice hereunder affecting his land or entry, notify the Secretary of the Interior, in the manner to be prescribed by said Secretary, of his acceptance of all of the terms and conditions of this act, and thereafter his lands or entry shall be subject to all of the provisions of this act.

of the reclamation law except out of appropriations made annually by Congress therefor, and the Secretary of the Interior shall, for the fiscal year nineteen hundred and sixteen, and annually thereafter, in the regular Book of Estimates, submit to Congress estimates of the amount of money necessary to be expended for carrying out any or all of the purposes authorized by the reclamation law, including the extension and completion of existing projects and units thereof and the construction of new projects. The annual appropriations made hereunder by Congress for such purposes shall be paid out of the reclamation fund provided for by the reclamation law.

1914—Act of Oct. 5, 1914 (38 Stat., 727)—An act to authorize the reservation of public lands for country parks and community centers within reclamation projects, and for other purposes.

That the Secretary of the Interior be, and he is hereby, authorized to withdraw from other disposition and reserve for country parks, public playgrounds, and community centers for the use of the residents upon the lands such tracts as he may deem advisable not exceeding twenty acres in any one township in each reclamation project or the several units of such reclamation projects undertaken under the act of June seventeenth, nineteen hundred and two, known as the reclamation act.

Sec. 2. That subject to the provisions hereinafter contained every such tract of land so set apart shall be supplied with water from the Government irrigation system, the cost thereof to be charged to the remaining lands of the projects as a part of the construction charge of such project, and shall be maintained and used in perpetuity by the people upon said reclaimed lands for a pleasure park, public playground, and community center.

Sec. 3. That for the purpose of carrying out and effecting the objects of this act the Secretary of the Interior is authorized to enter into a contract with the organization formed by the owners of the lands irrigated within said project or project unit pursuant to section six of the act of June seventeenth, nineteen hundred and two, stipulating and providing that the organization will maintain and use such of the lands so reserved for the purposes prescribed in this act as such organization may desire, and that upon failure to so maintain and use such lands, or in the event that same shall be permitted to be used or occupied for other purposes than those stipulated in this act, the control of the lands shall revert to the United States.

Sec. 4. That any of such lands not contracted for in accordance with the provisions of section three of this act within ten years from the time water is available for the same, or sooner, if the Secretary of the Interior may deem it desirable, shall be disposed of in accordance with the public-land laws applicable thereto, and the proceeds from the disposition of lands reverting to the United States under the provisions of this act, and from sales of water rights, shall be covered into the reclamation fund and placed to the credit of the project wherein the lands are situate.

1915—Act of Mar. 4, 1915 (38 Stat., 1215)—An act for the relief of homestead entrymen under the reclamation projects of the United States.

That any person who has made homestead entry under the act of June seventeenth, nineteen hundred and two (Thirty-second Statutes at Large, page three hundred and eighty-eight), for land believed to be susceptible of irrigation which at the time of said entry was withdrawn for any contemplated irrigation project, may relinquish the same provided that it has since been determined that the land embraced in such entry or all thereof in excess of twenty acres is not or will not be irrigable under the project, and in lieu thereof may select and make entry for any farm unit included within such irrigation project as finally established, notwithstanding the provisions of section five of the act of June twenty-fifth, nineteen hundred and ten, entitled "An act to authorize advances to the reclamation fund," and so forth, and acts amendatory thereof: *Provided,* That such entryman shall be given credit on the new entry for the time of bona fide residence maintained on the original entry.

1916—Act of July 26, 1916 (39 Stat., 390)—An act to amend section 14 of the reclamation extension act approved August 13, 1914.

That section fourteen of an act entitled "An act extending the period of payment under reclamation projects, and for other purposes," approved August thirteenth, nineteen hundred and fourteen, be amended so as to read as follows:

"Sec. 14. That any person whose land or entry has heretofore become subject to the reclamation law, who desires to secure the benefits of the extension of the period of payments provided by this act, shall, within six months after the issuance of the first public notice hereunder affecting his land or entry, notify the Secretary of the Interior, in the manner to be prescribed by said Secretary, of his acceptance of all the terms and conditions of this act, and thereafter his lands or entry shall be subject to all of the provisions of this act: *Provided,* That upon sufficient showing the Secretary of the Interior may, in his discretion, permit notice of acceptance of all the terms and conditions of this act to be filed at any time after the time limit hereinbefore fixed for filing such acceptance shall have expired, conditioned, however, that where the applicant for such acceptance is in arrears on construction charges he shall at the time of acceptance pay such installments of the construction charge as he would have been required to pay had he accepted this act within the time limit hereinabove fixed, plus the penalties that would have accrued had he so accepted, and such applicant shall thereafter be upon the same status that he would have been had he accepted the provisions of this act within the time limit hereinabove fixed, and thereafter the lands or entry of any such persons so filing such notice of acceptance shall be subject to all the provisions of this act."

1917—Act of Feb. 15, 1917 (39 Stat., 920)—An act to amend section one of the act of August 9, 1912, providing for patents on reclamation entries, and for other purposes.

That the proviso to section one of the act of August ninth, nineteen hundred and twelve, (Thirty-seventh Statutes, page two hundred and sixty-five), entitled "An act providing for patents on reclamation entries, and for other purposes," be amended to read as follows:

"*Provided,* That no such patent or final water-right certificate shall issue until after the payment of all sums due the United States on account of such land or water right at the time of the submission of proof entitling the homestead or desert-land entryman to such patent or the purchaser to such final water-right certificate."

APPENDIX 6

FINANCIAL STATEMENTS

Explanatory Note

Statements showing appropriations, receipts, expenditures, and financial data for a series of years constitute the most effective single means of exhibiting the growth and development of a service. Due to the fact that Congress has adopted no uniform plan of appropriations for the several services and that the latter employ no uniform plan in respect to the recording and reporting of their receipts and expenditures, it is impossible to present data of this character according to any standard scheme of presentation. In the case of some services the administrative reports contain tables showing financial conditions and operations of the service in considerable detail; in others financial data are almost wholly lacking. Careful study has in all cases been made of such data as are available, and the effort has been made to present the results in such a form as will exhibit the financial operations of the service in the most effective way that circumstances permit.

FINANCIAL STATEMENTS

TABLE 1

TOTAL RECEIPTS AND DISBURSEMENTS OF RECLAMATION FUND TO JUNE 30, 1917

Receipts		Expenditures	
Sales of public lands		Primary projects	$119,533,642.57
Audited	$91,890,082.85	Secondary projects	1,004,109.34
Not yet audited (estimated)	*1,300,000.00	Indian projects	2,907,137.11
Sale of town site lots	333,163.37	Miscellaneous	4,479,881.63
Rio Grande Dam appropriation	1,000,000.00	Rio Grande Dam	1,000,091.78
Advances to Reclamation fund (Act of June 25, 1910)	17,000,000.00	Total	$128,924,862.43
Collections			
Construction charges	4,796,724.91		
Operation and maintenance charges (including temporary water rentals)	7,191,291.14		
Sale of power and light	1,503,516.97		
Misc. sales	2,064,727.04		
Misc. services	1,619,856.36		
Transportation refunds	338,424.02		
Forfeiture by bidders and contractors	82,758.71		
Over disbursements	39,963.45	Balance in Reclamation Fund, July 30, 1917	1,928,980.08
From Indian Service	2,993,333.69		
Total	$132,153,842.51	Total	$130,853,842.51
*Deduct sales of public lands not yet audited and not taken into Reclamation Fund	1,300,000.00		
Total	$130,853,842.51		

TABLE 2

TOTAL RECEIPTS AND DISBURSEMENTS OF RECLAMATION FUND TO JUNE 30, 1917, BY YEARS

Fiscal Years	Total Receipts	Total Disbursements
1901	$ 3,144,821.91	———
1902	4,585,520.53	———
1903	8,714,238.97	$ 269,094.47
1904	6,826,964.43	1,513,431.22
1905	4,806,854.24	3,767,921.78
1906	5,189,261.13	7,107,715.90
1907	9,072,116.16	12,533,916.06
1908	9,961,608.88	11,800,025.12
1909	8,519,891.76	10,390,401.84
1910	8,810,880.56	10,050,736.30
1911	8,239,361.71	9,556,331.62
1912	8,127,551.68	11,663,199.00
1913	6,115,810.61	8,791,905.27
1914	9,717,890.35	10,437,940.81
1915	14,177,564.75	14,213,172.90
1916	8,518,265.80	8,805,940.21
1917	6,325,239.04	8,023,129.93
Total	$130,853,842.51	$128,924,862.43

TABLE 3

Disbursements and Collections on Primary Projects, by Projects, to June 30, 1917

State	Project	Net Disbursements				Collections			Net Investment
		Disbursements	Transfers Issued	Transfers Received	Net Disbursements	Construction Charges	O. & M. Charges	Miscellaneous	
Arizona	Salt River	14,012,725 37	66,719 65	474,871 32	14,420,877 04	100,000 00	.....	3,821,851 03	10,499,026 01
" California	Yuma	9,180,085 43	95,377 32	284,496 92	9,369,205 03	276,612 92	79,214 40	494,334 57	8,519,043 14
California	Orland	980,584 26	5,255 15	52,482 96	1,027,812 07	17,787 66	.....	134,511 27	875,513 14
Colorado	Grand Valley	2,981,447 77	11,518 50	144,986 63	3,114,915 90	.....	.....	33,565 57	3,081,350 33
"	Uncompahgre	6,701,634 40	35,118 54	178,109 05	6,844,624 91	.....	.....	597,122 98	6,247,501 93
Idaho	Boise	12,448,774 76	139,257 57	463,666 50	12,773,183 69	.....	.....	1,025,470 72	11,747,712 97
"	Minidoka	6,280,633 28	228,423 62	333,235 32	6,385,444 98	501,178 11	384,167 11	554,814 13	4,945,285 63
Kansas	Garden City	380,110 76	11,606 28	12,294 10	380,798 58	.....	.....	4,597 47	376,201 11
Montana	Huntley	1,937,929 85	160,558 45	96,883 71	1,874,255 11	280,210 99	136,130 28	84,130 03	1,373,783 61
"	Milk River	2,845,104 11	36,846 29	153,297 31	2,961,555 13	.....	.....	46,400 50	2,915,154 63
"	St. Mary Storage	2,175,482 39	55,116 94	221,497 46	2,341,862 91	.....	.....	57,716 47	2,284,146 44
"	Sun River	3,291,273 98	72,548 38	174,661 24	3,393,386 84	115,200 63	49,579 00	73,156 97	3,155,450 24
" N. Dak	Lower Yellowstone	3,339,586 81	41,344 48	106,830 90	3,405,073 23	35,906 27	36,801 81	89,223 11	3,243,142 04
Nebraska-Wyoming	North Platte	8,493,692 71	28,010 55	272,680 47	8,738,362 63	505,950 43	434,394 69	144,326 58	7,653,690 93
Nevada	Truckee-Carson	6,276,322 85	51,101 31	299,183 42	6,524,404 96	314,614 34	234,323 25	163,638 01	5,811,829 36
New Mexico	Carlsbad	1,423,488 75	13,986 47	62,402 18	1,471,904 46	160,304 83	161,755 38	34,779 95	1,115,064 30
" "	Hondo	392,784 15	1,000 76	14,954 73	406,738 12	.....	.....	34,617 67	372,120 45
" Texas	Rio Grande	6,211,629 04	123,816 90	359,553 10	6,447,365 24	.....	.....	609,967 73	5,837,397 51
North Dakota	N. Dak. Pumping	1,063,980 82	183,408 16	199,861 98	1,080,434 64	8,966 62	13,283 35	115,925 57	942,259 10
Oklahoma	Lawton	11,512 28	599 00	2,433 07	13,346 35	.....	.....	20	13,346 15
Oregon	Umatilla	2,647,158 90	95,235 99	89,840 67	2,641,763 58	225,304 94	91,327 69	92,701 26	2,232,429 69
" California	Klamath	3,049,164 53	31,874 71	96,177 56	3,113,467 38	305,745 21	163,223 13	68,054 17	2,576,444 87
South Dakota	Belle Fourche	3,828,227 61	37,988 56	106,316 24	3,896,555 29	211,258 44	173,973 91	101,231 98	3,410,090 96
Utah	Strawberry Valley	3,477,091 39	54,223 49	134,535 63	3,557,403 53	48,359 32	19,076 57	234,978 45	3,254,989 19
Washington	Okanogan	916,592 63	11,025 41	40,683 82	946,251 04	24,682 19	37,040 94	102,202 30	782,325 61
"	Yakima, Storage	2,711,186 97	45,240 82	256,806 87	2,922,753 02	300,690 00	150 00	120,642 72	2,501,270 30
"	" Sunnyside	3,943,087 31	89,508 52	72,549 49	3,926,128 28	729,828 39	620,683 74	118,567 56	2,457,048 59
"	" Tieton	3,326,405 88	331,109 65	470,392 64	3,465,688 87	323,033 84	185,027 06	83,986 41	2,873,641 50
Wyoming	Shoshone	5,205,943 58	52,612 40	208,166 34	5,361,497 52	302,537 65	152,127 71	213,869 94	4,692,962 22
Total		119,533,642 57	2,110,433 87	5,383,851 63	122,807,060 33	4,788,172 78	2,972,280 02	9,256,442 32	105,790,165 21

APPENDIX 7

STATISTICS OF CONSTRUCTION

STATISTICS OF CONSTRUCTION, JUNE 30, 1917 [1]

	Acres	Farms
LANDS		
Estimated area of projects on completion	3,072,795 [2]	62,451
Estimated area to which service was prepared to supply water	1,797,811	37,719
Under contract	1,395,939	29,134
Water rights	(597,631)	(12,724)
Rental contracts, etc.	(778,308)	(16,410)
	Acre-feet	
Reservoir capacity available	9,193,800	
CANALS, DITCHES, AND DRAINS	Miles	
Canals over 800 second-feet capacity	401	
Canals 301 to 800 second-feet capacity	665	
Canals 50 to 300 second-feet capacity	1,678	
Canals less than 50 second-feet capacity	7,226	
Total canals	9,970	
Waste-water ditches	456	
Drains, open	575	
Drains, closed	149	
Total	1,180	
Grand total	11,150	
TUNNELS		
Number	94	
Length, feet	141,987	
STORAGE AND DIVERSION DAMS	Cubic yards	
Masonry	2,083,376	
Earth	9,818,103	
Rock fill and crib	1,155,763	
Total	13,057,242	

[1] Includes data on Indian projects.
[2] Including areas furnished temporary water supply.

DIKES AND LEVEES	Miles	Cu. yds.
Length and volume	94.5	4,430,190
	Concrete	Wood
CANAL STRUCTURES		
Costing over $2,000	902	134
Costing $500 to $2,000	1,866	430
Costing $100 to $500	7,946	4,794
Costing less than $100	13,754	51,617
Total	24,468	56,975
	Number	Length
BRIDGES		Feet
Steel	104	7,002
Combination	412	11,924
Wood	4,966	108,226
Concrete	335	4,174
Total	5,817	131,326
CULVERTS		
Concrete	1,654	80,371
Metal	1,346	48,977
Terra cotta	920	44,339
Wood	3,068	69,346
Total	6,988	243,033
PIPE	Linear feet	
Concrete	556,918	
Metal	239,400	
Terra cotta (tile)	1,046,770	
Wood	331,380	
Total	2,174,468	
	Number	Length
FLUMES		Feet
Concrete	76	14,870
Metal	674	142,084
Wood	1,679	362,134
Total	2,429	519,088

	Concrete	Wood
CANALS LINED		
Length, miles	296.9	4.1
BUILDINGS		
Offices, number		79
Residences, do		566
Power plants, do		26
Pumping stations, do		67
Barns, storehouses, etc, do		446
Total		1,184

	Number	Depth
		Feet
WELLS		
Number and depth	391	34,583
COMMUNICATIONS	Miles	
Roads		902
Railroads		83
Telephones		2,822
Transmission lines		442
POWER DEVELOPED		
Water and steam, horsepower		47,361
EXCAVATION	Cubic yards	
Class 1, earth		133,043,727
Class 2, indurated material		8,882,812
Class 3, rock		7,859,995
Total		149,786,534
RIPRAP, cubic yards		1,527,920
PAVING, square yards		749,395
CONCRETE, cubic yards		2,942,775
CEMENT, barrels		2,741,763

APPENDIX 8

BIBLIOGRAPHY

Explanatory Note

The bibliographies appended to the several monographs aim to list only those works which deal directly with the services to which they relate, their history, activities, organization, methods of business, problems, etc. They are intended primarily to meet the needs of those persons who desire to make a further study of the services from an administrative standpoint. They thus do not include the titles of publications of the services themselves, except in so far as they treat of the services, their work and problems. Nor do they include books or articles dealing merely with technical features other than administrative of the work of the services. In a few cases explanatory notes have been appended where it was thought they would aid in making known the character or value of the publication to which they relate.

After the completion of the series the bibliographies may be assembled and separately published as a bibliography of the Administrative Branch of the National Government.

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1 U. S. *Dept. of agriculture. Library.* List of references to publications relating to irrigation and land drainage. Washington, Govt. print. off., 1902. 181 p. (*Its* Bulletin no. 41)

[1,778 titles, arranged in an author list, periodical list, and subject index]

2 —— *Office of experiment stations.* Organization, work, and publications of irrigation investigations. [Washington, Govt. print. off.] 1909. 12 p.

3 —— *Reclamation service.* Index. First to tenth annual reports of the Reclamation service. (*In its* Tenth annual report, 1910/1911.) Washington, Govt. print. off., 1912. p. 251-90.

4 U. S. *Reclamation service.* List of engineering articles [relating to the work of the Service] With index. no. 1-4. Washington, Govt. print. off., 1915-1918.

[Reprinted from the 12th, 14th, 15th and 16th annual reports of the U. S. Reclamation service]

5 —— —— Publications of the United States Reclamation service . . . for sale by the U. S. Reclamation service, Washington, D. C., December, 1917. [Washington, D. C., 1917] 85 p. (List of publications no. 4)

6 —— —— Reports and bulletins relating to the work of the Reclamation service. (*In its* Publications. Washington, 1917. p. 47-56)

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11 Newell, Frederick H. Proceedings of first conference of engineers of the Reclamation service, with accompanying papers . . . Washington, Govt. print. off., 1904. 361 p. (U. S. Geological survey. Water-supply and irrigation paper no. 93)

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15 Newlands, Francis G. Development of the West. Articles on western topics, entitled: "Watering the desert," "National irrigation as a social problem," and "Dry farming." Washington, Govt. print. off., 1914. 16 p. ([U. S.] 63d Cong., 2d sess. Senate. Doc. 588) Serial no. 6596

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17 —— Storage reservoirs—the arid-land question. Speech . . . in the House of representatives, Wednesday, January 9, 1901. Washington [Govt. print. off.] 1901. 30 p.

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[Report submitted to the Secretary of the interior. Signed (p. 19) John Biddle . . . W. C. Langfitt . . . Wm. W. Harts . . . C. W. Kutz . . . H. Burgess . . . This Board made an inspection of nearly all the projects from July 28 to Oct. 22, 1910. Public hearings were held on each project. The cost of this inspection to the Reclamation fund was $15,988.09]

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37 —— —— —— Hearings . . . February 1, 2, 3, 5, 8, 9, 10, 11, 1909, relating to present condition of the reclamation projects, returns to the fund, organization and methods of work of the Reclamation service. Washington, Govt. print. off., 1909. 144 p.

38 —— —— —— Hearings . . . April 23; June 1 and 8, 1910. Relating to proposed legislation, present condition of reclamation projects, returns to the reclamation fund, business methods of the Reclamation service, success of settlers. Washington, Govt. print. off., 1910. 189 p.

39 —— —— —— Hearings . . . Relating to proposed legislation, present condition of reclamation projects, success of settlers, returns to reclamation fund, crops, etc. January 27, February 3 and 8, 1912. Washington, Govt. print. off., 1912. 253 p.

40 —— —— —— Irrigation in Nebraska. Hearing on H. J. res. 315 relating to irrigation projects in the state of Nebraska. Aug. 13, 1914. Washington, Govt. print. off., 1914. 35 p.

41 —— —— —— Irrigation projects. Hearings . . . Feb. 24, 1912. Washington, Govt. print. off., 1912. 26 p.

[Statements of Carl Hayden, John P. Orme and others]

42. U. S. *Congress. House. Committee on irrigation of arid lands.* Irrigation projects. Hearings . . . concerning proposed changes in the reclamation law. [H. R. 20490] Feb. 23, 1912. no. 2. Washington, Govt. print. off., 1912. p. 27-36.

43 —— —— —— Irrigation projects. Hearings. Statement of Mr. James T. Whitehead, of Mitchell, Neb. March 2, 1912 [on H. R. 20490] Washington, Govt. print. off., 1912. 24 p.

44 —— —— —— Irrigation projects. Hearings . . . Town site improvements. Mar. 13, 1912. no. 1. [H. R. 10443] Washington, Govt. print. off., 1912. 26 p.

[Statements of P. P. Wells and W. D. Buchholz]

45 —— —— —— Irrigation projects. Town site improvements. no. 2. Hearings . . . on H. R. 10443 . . . and on H. R. 22873. April 20, 1912. Washington, Govt. print. off., 1912. 18 p.

[Statements by Mr. Mondell, Mr. F. H. Newell and others]

46 —— —— —— Proposed irrigation projects. Hearings . . . April 15, 1916. Washington, Govt. print. off., 1916. 34 p.

47 —— —— —— Reclamation of arid lands . . . Report [with views of the minority. To accompany H. R. 9676. Washington, Govt. print. off., 1902] 18, 17 p. (57th Cong., 1st sess. House. Rept. 794) Serial no. 4402

[A bill appropriating the receipts from sale and disposal of public lands in certain states and territories to the construction of irrigation works for the irrigation of arid lands. *cf.* [pt. 1, p. 1] The Majority report strongly urged the passage of the bill; the Minority report declared it to be unconstitutional and impracticable]

48 —— —— —— Stimulation of food production under reclamation projects. Hearings . . . on H. R. 2913 a bill to stimulate the production of food upon private and public lands within the reclamation projects and for other purposes . . . April 16, 1917. Washington, Govt. print. off., 1917. 25 p.

49 —— —— —— Stimulation of food production . . . Report. [To accompany H. R. 4431] [Washington, Govt. print. off., 1917] 11 p. (65th Cong., 1st sess. House. Rept. 107)

50 —— —— —— Title for homesteaders on reclamation projects. Hearings . . . on H. R., 23242 . . . May 11, 1912. no. 1. Washington, Govt. print. off., 1912. 5 p.

51 —— —— —— To promote the reclamation of arid lands on the public domain. Hearings . . . on H. R. 262. Feb. 26, 1916. Washington, Govt. print. off., 1916. 28 p.

52 —— —— *Committee on public lands.* Hearings . . . relating to the reclamation and disposal of the arid public lands of the West. January 11 to 30, 1901. Washington, Govt. print. off., 1901. 135 p. illus.

[Statements of Mr. Newlands, Mr. Maxwell, Mr. Newell, and others]

53 U. S. *Congress. House. Committee on ways and means.* Reclamation bonds. Hearings before the Committee on ways and means of the House of representatives, 61st Congress, 2d session, on H. R. 18398, H. R. 19079, H. R. 21893, and S. 5705, February 5, March 8, 10, 11, 14, 15, 17, 28, 30, 1910. Washington, Govt. print. off., 1910. 265, 265a-265d p.

54 —— —— *Select committee on irrigation.* Hearings before the Select committee on irrigation, House of representatives, Fifty-first Congress, on the general subject of irrigation in the United States [February 6 to April 24, 1890] Washington, Govt. print. off., 1890. 38, 134 p.

55 —— —— *Senate. Committee on irrigation and reclamation of arid lands.* Corbett tunnel claims, Shoshone project, Wyoming. Hearing . . . on S. 4862, a bill authorizing . . . the Secretary of the interior to investigate and settle certain accounts . . . Feb. 29, 1912, April 27 and Mar. 4, 1912. Washington, Govt. print. off., 1912. 18, 26, 19 p.

56 —— —— —— Flood waters of the Rio Grande. Hearing before a subcommittee . . . on S. J. res. 183; a joint resolution for control and distribution of the flood waters of the Rio Grande. Washington, Govt. print. off., 1915. 41 p.

57 —— —— —— Government aid through district organizations. Hearings . . . on S. 1922, a bill relating to the reclamation of arid, semi-arid, swamp, and overflow lands through district organizations, and authorizing government aid therefor. March 28-31, 1916. Washington, Govt. print. off., 1916. 132 p.

58 —— —— —— Issue of certificates by water users' associations . . . [Washington, Govt. print. off., 1908] 17 p. (60th Cong., 1st sess. Senate. Doc. 507) Serial no. 5269

[Statement of F. H. Newell, director of the Reclamation service]

59 —— —— —— Private irrigation projects, Carey act. Hearing . . . on private irrigation projects, Carey act. [Jan. 15, 1912] . . . Washington, Govt. print. off., 1912. 34 p.

[Statements of Mr. Samuel H. Hays, Boise, Idaho, and Mr. L. C. Hill, supervising engineer, United States Reclamation service]

60 —— —— —— Report . . . on the investigation of irrigation projects . . . (To accompany S. Res. 324) Washington, Govt. print. off., 1911. 917 p. (61st Cong., 3d sess. Senate. Report 1281) Serial no. 5846

61 —— —— —— Salt River irrigation project—Arizona. Hearing . . . on Salt River irrigation project, Arizona. February 29, 1912 . . . Washington, Govt. print. off., 1912. 24 p.

[Statement of J. P. Orme and Daniel P. Jones]

62 —— —— —— Suggestions for report of Senate Committee on irrigation. By Francis G. Newlands. [Washington, Govt. print. off., 1911] 20 p.

63 —— —— *Select committee on irrigation and reclamation of*

arid lands. Report of the special committee of the United States Senate on the irrigation and reclamation of arid lands . . . Washington, Govt. print. off., 1890. 6 v. illus. (51st Cong., 1st sess. Senate. Rept. 928) Serial no. 2707-8

[CONTENTS.—pt. 1. Report of committee and views of the minority.—pt. 2 (vol. I). The Northwest.—pt. 3 (vol. II). The Great Basin region and California.—pt. 4 (vol. III). Rocky Mountain region and Great Plains.—pt. 5 (vol. IV). Statements by Director Powell and other officers of the U. S. Geological survey. Consular reports. General report on irrigation in United States. Miscellaneous papers.—pt. 6. Irrigation in the United States. By R. J. Hinton . . . being a 2d ed. of Misc. doc. 15, 49th Cong., 2d sess.]

64 U. S. *Dept. of agriculture.* Truckee-Carson-Lake Tahoe project. Letter from the Secretary of agriculture, transmitting, in response to House resolution no. 270, information relating to Truckee-Carson-Lake Tahoe project . . . Washington [Govt. print. off.,] 1912. 160 p. (62d Cong., 2d sess. House. Doc. 451) Serial no. 6321

65 —— *Dept. of the interior.* Demonstration farms. Letter . . . transmitting a copy of a communication from the Secretary . . . submitting an estimate of appropriation for establishment of demonstration farms in connection with the various reclamation projects. [Washington, Govt. print. off., 1905] 9 p. (59th Cong., 1st sess. House. Doc. no. 213) Serial no. 4986

66 —— —— Expenditures on irrigation projects in Indian reservations, cost account of all moneys, from whatever source derived, expended on each project on Indian reservations, allotments, and lands, fiscal year 1916. Dec. 7, 1916. Washington, Govt. print. off., 1916. 13 p. (64th Cong. 2d sess. House. Doc. 1451) Serial no. 7241

67 —— —— General reclamation circular, approved May 18, 1916. Laws and regulations relating to the reclamation of arid lands by the United States. Washington, Govt. print. off., 1916. 72 p.

68 —— —— Reclamation projects. Letter from the Secretary of the interior, transmitting information in compliance with Senate resolution of February 10, 1910, as to the amount of money required to finish reclamation projects now under consideration, and the amount of money expended upon each of the projects, etc. . . . [Washington, Govt. print. off., 1910] 31 p. (61st Cong., 2d sess. Senate. Doc. 376) Serial no. 5657

69 —— ——Waters of the Rio Grande and its tributaries. Letter from the Secretary of the interior, transmitting . . . orders and regulations of the Interior department touching use, appropriation, or disposition for irrigation of the waters of the Rio Grande and its tributaries in Colorado and New Mexico . . . [Washington, Govt. print. off., 1911] 21, 197 p. (62d Cong., 1st sess. House. Doc. 39) Serial no. 6117

[Fund for reclamation of arid lands. Message from the President of the United States, transmitting a report of the Board of army engineers in relation to the reclamation fund. (Reprint from House doc. no. 1262, Sixty-first Congress, third session): p. 1-197]

70 U. S. *Dept. of the interior. Carey act committee.* Carey act projects. Report of a committee appointed by the Secretary of the interior to make an investigation into and report upon the history and present condition of the Carey act projects . . . Washington, Govt. print. off., 1913. 22 p. (62d Cong., 3d sess. Senate. Doc. 1097) Serial no. 6365

[Signed: Herman Stabler, P. R. Dudley, F. W. Hanna, Carey act committee.]

71 —— —— *Central board of review.* Report of the Central board of review on the Carlsbad project, New Mexico. Reclamation record, July, 1916, v. 7: 298-308.

72 —— —— —— Report of the Central board of review on the Shoshone project, Wyoming. Reclamation record, Oct., 1916, v. 7: 463-9.

73 —— —— —— Report of the Central board of review on the Belle Fourche project, South Dakota. Reclamation record, Dec., 1916, v. 7: 549-50.

74 —— —— —— Report of the Central board of review on the Salt River project, Arizona. Reclamation record, Jan., 1917, v. 8: 14-21.

75 —— —— —— Report of the Central board of review on the Rio Grande project, New Mexico-Texas. Reclamation record, Feb., 1917, v. 8: 82-6.

76 —— —— —— Report of the Central board of review on the Uncompahgre Valley project, Colorado. Reclamation record, March, 1917, v. 8: 127-32.

77 —— —— —— Report of the Central board of review on the North Platte project, Nebraska-Wyoming. Reclamation record, April, 1917, v. 8: 179-83.

78 —— *Engineer dept.* Preliminary examination of reservoir sites in Wyoming and Colorado. Letter from . . . the Chief of Engineers, together with a report from Captain Chittenden of a preliminary examination made by him of certain reservoir sites in the states of Wyoming and Colorado. [Washington, Govt. print. off., 1897] 110 p. illus. 55th Cong., 2d sess. House. Doc. no. 141) Serial no. 3666

[Captain Hiram M. Chittenden recommended that the government acquire full title and jurisdiction to any reservoir site which it might improve and full rights to the water necessary to fill the reservoir; also that it should build, own, and operate the works, holding the stored waters free for public use under local regulations]

79 —— —— San Carlos irrigation project, Arizona. Report to the secretary of war of a board of engineer officers, United

States army, under Indian appropriation act of August 24, 1912, on the San Carlos irrigation project, Arizona . . . Washington [Govt. print. off.] 1914. 168 p. (63d Cong., 2d sess. House. Doc. 791) Serial no. 6755

80 U. S. *General land office.* Laws and regulations relating to the reclamation of arid lands by the United States. Approved April 29, 1912. Washington, Govt. print. off., 1912. 39 p. (Circular no. 102)

81 —— *Geographical and geological survey of the Rocky Mountain region.* Report on the lands of the arid region of the United States, with a more detailed account of the lands of Utah. With maps. By J. W. Powell . . . Washington, Govt. print. off., 1878. 195 p. 3 fold. maps. (45th Cong., 2d sess. House. Ex. doc. no. 73) Serial no. 1805

[The first scientific study of irrigation as an economic problem]

82 —— *Geological survey.* Report of progress of stream measurements for . . . 1901-1905 . . . Washington, Govt. print. off., 1903-06. 35 v. (Water-supply and irrigation paper no. 75, 82-85, 97-100, 124-135, 165-178)

[Reports for 1896-1900 were published in pt. 4 of the 18th-22d annual reports of the Geological survey, supplemented by "Operations at river stations," issued in the series of Water-supply and irrigation papers. Later reports issued under title: "Surface water supply", etc. (Water supply paper no. 201-214, 241-252, 261-272, 281-292, 301-312, 321-332, 351-362, 381-393)]

83 —— —— Report on Soda Lakes investigation, Truckee-Carson project, near Fallon, Nev., by Charles H. Lee, consulting engineer, and W. O. Clark, assistant geologist, United States Geological survey. Washington, Govt. print. off., 1916. p. 657-706.

84 —— *Laws, statutes, etc.* An act appropriating the receipts from the sale and disposal of public lands in certain states and territories to the construction of irrigation works for the reclamation of arid lands and subsequent acts pertaining thereto. Washington [Govt. print. off.] 1911. 11 p.

85 —— —— A bill to promote the reclamation of arid and swamp lands of the United States, and for other purposes. [Washington, Govt. print. off., 1916] 9 p. (64th Cong., 2d sess. S. 7487)

[Introduced in the House of representatives, Dec. 2, 1916, by Mr. Smith of Idaho, and in the Senate by Mr. Chamberlain of Oregon, Dec. 20, 1916. Reprinted in Irrigation age, Feb. 1917, v. 32: 59-60; also in Reclamation record, April, 1917, v. 8; 165-7.]

86 —— —— Laws relating to the reclamation of arid lands by the United States. Washington [Govt. print. off.] 1911. 40 p.

87 —— *Office of experiment stations.* Organization, work, and publications of irrigation investigations. [Washington, Govt. print. off.] 1909. 12 p.

88 U. S. *Office of irrigation inquiry.* [Report on irrigation. 1893] Washington, Govt. print. off., 1893. 4 v. in 1. (52d Cong., 1st sess. Senate ex. doc. 41) Serial no. 2899

89 —— *President, 1901-1909 (Roosevelt)* [Remarks on reclamation of arid lands . . . in message of Dec. 3, 1901] (*In* Compilation of the messages and papers of the Presidents. New York, n. d. v. 15: 6655-8)

90 —— *Reclamation service.* Annual report. 1902—date. Washington, Govt. print. off., 1903—date.

["The First annual report of the Reclamation service, dated Nov. 29, 1902, gave a brief description of the location and condition of the arid public lands and summarized the history of the national irrigation movement, the laws recognizing irrigation, and the conditions of the work of reclamation in the various states and territories.

The Second annual report took up the general discussion of the reclamation law, reciting decisions of the Secretary of the Interior concerning it, and described in detail the work begun, showing in particular what had been accomplished in 1903.

The Third and later reports continue a description of the work begun and operations carried on during the calendar year; together with the Reclamation act and acts of Congress affecting operations thereunder.

The Eleventh report presents a review of the conditions existing at the time of the passage of the Reclamation act, the operations and results accomplished during the decade, and mention of the lessons taught thereby.

The Fifteenth report contains a history of the construction of each project from the beginning of work to June 30, 1916."]

91 —— —— Bulletin of information for the Committee on appropriations of the House . . . 64th Congress. Tour of inspection and examination of reclamation projects, June 1 to July 15, 1915. Washington, Gov. print. off., 1915. 36 p.

[Suggestions for reclamation trip]

92 —— —— Discussion of projects from the Thirteenth annual report together with detail estimates of work to be accomplished with the money recommended for appropriation for the fiscal year 1916 compared with expenditures during the fiscal year 1914. Washington, Govt. print. off., 1915. 500 p.

—— —— [Handbooks of the Reclamation service]

93 Instructions for accounting and fiscal affairs, 1909. Washington, Gov. print. off., 1909. 2 v.

94 Instructions to operation employees. Truckee-Carson project, Nevada. 1908. 19 p.

95 Instructions under act approved July 26, 1916, providing for acceptance of terms of reclamation extension act. [1916] 3 p.

96 Manual of field accounting. Washington, 1907. 95 p.

97 Manual of the United States Reclamation service. (Ed. of 1917) A. P. Davis, director . . . Washington [Govt. print. off.] 1917. 566 p.

98 Measurement of irrigation water. [n. p.] 1913. 59 p.

99 Operation and maintenance use book. Washington, 1914. 192 p.

[Deals with the operation and maintenance of completed works, delivery of water, and relations between the water users and operating force. A later edition of the "use-book" was published in the Manual (1917) p. 324-66]

100 U. S. *Reclamation service.* Irrigation projects of the U. S. Reclamation service . . . National reclamation of arid lands. [Washington, Govt. print. off., 1915] [24] p.

101 —— —— Irrigation revival. [Suggestions by F. H. Newell to the members of the Interstate Irrigation Commission. Mar. 10, 1915. Washington, 1915] 9 p.

102 —— —— Organization of water users' associations, 1913. Washington, Govt. print. off., 1913. 31 p.

103 —— —— Proposed work on reclamation projects during fiscal year 1918 with estimates of appropriation. Washington, Govt. print off., 1916. 70 p.

104 —— —— Questions and answers relating to the Reclamation act and its operations. Approved by the acting secretary of the interior, September 21, 1909. Washington, Govt. print. off., 1909. 30 p.

105 —— —— Reclamation record . . . Washington, 1908—date.

[Jan.-April 1908 have title: The monthly bulletin of the United States Reclamation service. "This journal gives an account of the construction, operation and maintenance work of the Service and contains illustrated articles of interest to water users and to others having to do with irrigation matters."]

106 —— —— Salt River project, Arizona. Limiting irrigable area of land. Jan. 15, 1914. [Wash., Govt. print. off.] 1914. 64 p. 2 charts.

107 —— —— Wind River project, Wyoming . . . report . . . on the Wind River, Wyoming, project. Dec. 18, 1916. Washington, Govt. print. off., 1917, 90 p. (64th Cong., 2d sess. House. Doc. no. 1767) Serial no. 7240

U. S. *Reclamation service.* [United States Reclamation service in cooperation with state of California]

108 *California. Engineer dept.* California cooperative work. . . . United States Reclamation service in cooperation with state of California. Report on Pit River basin, by the Reclamation service office at Portland, Oregon. E. G. Hopson, supervising engineer, O. W. Peterson, engineer. April, 1915. [Sacramento] California state printing office, 1915. 140 p.

109 —— —— Cooperative investigations in California . . . U. S. Reclamation service in cooperation with the Northern California irrigation association. Report on Lower Pit River project . . . July, 1915. Washington, Govt. print. off., 1915. 55 p.

110 —— —— Cooperative investigations in California . . . U. S. Reclamation service in cooperation with Iron Canyon project

association. Report on Iron Canyon project . . . and Report by Board of review . . . Nov. 1914. 147 p. illus., maps.

U. S. *Reclamation service.* [United States Reclamation service in cooperation with state of Oregon]

111 *Oregon State engineer.* Deschutes project . . . Portland, 1914. 147 p. maps.

112 —— —— Harney and Silver Creek projects, irrigation and drainage . . . [Denver, Smith-Brooks press] 1916. 91 p. maps.

113 —— —— John Day project, irrigation and drainage . . . [Portland, Portland printing house company] 1916. 185 p. maps.

114 —— —— Malheur and Owyhee projects, irrigation and drainage . . . [Denver, Smith-Brooks press] 1916. 201 p. maps.

115 —— —— Ochoco project and Crooked River investigations . . . Washington, Govt. print. off., 1915. 98 p. 49 pl., fold. map.

116 —— —— Rogue River Valley project and Willamette Valley investigations . . . [Denver, Smith-Brooks press] 1916. 111 p. maps.

117 —— —— Silver Lake project, irrigation and drainage. [Portland, Ore., Independent printing co.] 1915. 179 p. maps.

118 —— —— Warner Valley and White River projects (irrigation and drainage) . . . Washington, Govt. print. off., 1916. 123 p. maps.

119 U. S. *Signal office.* Irrigation and water storage in the arid regions. Letter from the Secretary of war, transmitting a report of the chief signal officer of the army, in response to House resolution dated May 23, 1890, relating to irrigation and water storage in the arid regions . . . Washington, Govt. print. off., 1891. 356 p. 37 fold. maps, 6 charts. (51st Cong., 2d sess. House. Ex. doc. no 287) Serial no. 2868.

[Contents.—Report on the climatology of the arid regions of the United States, with reference to irrigation, by A. W. Greely, chief signal officer, U. S. army.—Appendices, 1-64. (Charts and tables of precipitation and temperature)—65-67. Reports on climate of Arizona, New Mexico, California and Nevada, by W. A. Glassford.]

Unofficial Publications: Books and Pamphlets

120 American society of irrigation engineers. Transactions. v. 1— Denver [1894—]

121 Bartlett, Dana W. The better country, . . . Boston, Mass., The C. M. Clark publishing co. [1911] 554, [7] p.

[Describes the U. S. Reclamation service as an agency for the making of a "Better country"]

122 Blanchard, Clarence J. Home-making by the government, an account of the eleven immense irrigating projects to be opened in 1908. Reprinted from the National geographic magazine,

April, 1908. Washington, D. C., Press of Judd & Detweiler, inc., 1908. p. 250-87. illus.

123 Blanchard, Clarence J. Millions for moisture, an account of the work of the U. S. Reclamation service. Reprinted from the National geographic magazine, April, 1907. Washington, D. C., Press of Judd & Detweiler, inc., 1907. p. 217-43. illus.

124 Brown, Hugh A. Inoculation of the field force of the United States Reclamation service with anti-typhoid vaccine. [1913] 8 p.

[From "The American practitioner," April, 1913]

125 —— Typhoid inoculation in the Reclamation service. Philadelphia, J. B. Lippincott co., c1916. 4 p. chart.

[Reprinted from International clinics, v. 2, series 26.]

126 Chamber of commerce of the United States of America. The story of irrigation, being the civilization of the desert. Washington, D. C., 1916. 8 p. (Special bulletin, Nov. 24, 1916)

[Statement is made that "the most far-reaching, scientific, and comprehensive method of irrigation is that undertaken by the Federal government under the authority of the Reclamation act of June, 1902"]

127 Davis, Arthur P. Engineering work of the United States Reclamation service. (*In* Pan American scientific congress. Proceedings of the second . . . congress, Washington, D. C., Dec. 27, 1915-Jan. 8, 1916. Washington, 1917. v. 3: 283-92)

128 —— Irrigation works constructed by the United States government. New York, John Wiley and sons, 1917. 413 p. illus.

[The Chief engineer of the U. S. Reclamation service gives engineering descriptions of the various projects undertaken by the Service, for the benefit of the engineering profession. Reviewed in Engineering-news-record, Nov. 15, 1917, v. 79: 939-40]

129 Foley, Frank. Suggestions for the irrigation of western lands to procure employment and homes for the laboring people of the United States. [Chicago, 1894] 20 p.

130 Gray, Edward D. McQueen. Government reclamation work in foreign countries; compiled from consular reports and official documents. Washington, Govt. print. off., 1909. 115 p.

131 Grunsky, C. E. Irrigation enterprise in the United States. (*In* International engineering congress, 1915. Transactions . . . San Francisco, 1915. v. 2. Waterways and irrigation, p. 342-70. Paper no. 34)

132 Harding, Sidney T. Operation and maintenance of irrigation systems. New York, McGraw-Hill book co., 1917. 271 p. illus.

[Extensive references to work of the Reclamation service]

133 International engineering congress, San Francisco, 1915. Transactions. San Francisco, Cal., 1916. 12 v. in 13.

[Vol. 2 is devoted to the subject of irrigation]

134 International irrigation congress. Official proceedings. 1st to 21st congresses, 1891-1914. Salt Lake City [etc.] 1891-1914.

[Mr. William E. Smythe was the prime mover in organizing the National irrigation congress. The discussions at these congresses helped to formulate a national irrigation policy. "The papers are published nearly every year and contain addresses by officials of the Reclamation service and others. The last issued is for the 21st Congress, at Alberta, Canada, October, 1914, and includes 402 pages."]

135 Irrigated lands in the United States. Descriptions of all reclamation service projects—their location, acreage, cost of water rights, suitable crops, markets, railroad facilities and principal towns. Complete list of government irrigated lands and Carey act projects. Many important private irrigation enterprises. St. Paul, Minn., Webb publishing company, 1911. 66 p.

136 James, George W. Reclaiming the arid West; the story of the United States Reclamation service. New York, Dodd, Mead and co., 1917. 411 p. illus.

[The author characterizes the achievements of the Reclamation service as the most beneficial governmental work of all history]

137 Lewis, A. D. Irrigation and settlement in America . . . Pretoria, The government printing and stationery office, 1915. 258 p. illus. (incl. plans, diagrs.) 19 pl. (incl. maps)

[Description of principal irrigation projects of the Reclamation service, by the Circle engineer, Irrigation department, Union of South Africa. Reviewed in Engineering news, June 15, 1916, v. 75: 1136]

138 Mead, Elwood. Irrigation institutions; a discussion of the economic and legal questions created by the growth of irrigated agriculture in the West . . . New York, The Macmillan company, 1903. 392 p. illus., diagrs. (*Half-title:* The citizen's library of economics, politics, and sociology, ed. by R. T. Ely)

139 Mieir, William O. A possible method of reclamation for the arid West . . . [Westminster? Col., c1909] 21 p.

140 Minidoka and Southwestern railroad company and Utah construction company, *appellants.* [Action concerning the right to build and operate a railroad through a reclamation project without consulting the government.] Brief for the United States. Washington, Govt., print. off., 1914. 47 p. (*In the* Supreme court of the United States, October term, 1914. No. 19)

141 National association of agricultural implement and vehicle manufacturers. *Committee on arid lands and irrigation.* Report of Committee on arid lands and irrigation, presented at the annual meeting of the National association of agricultural

implement and vehicle manufacturers held at Chattanooga, Tennessee, November 16, 17, 18, 1904 . . . [n. p., 1904?] 48 p.

[Committee: C. G. Rowley, O. V. Dodge and U. G. Orendorff. Committee thinks the bulk of irrigation development in the west will be found to be under private projects; it does not, however, oppose national aid]

National irrigation congress. *See* International irrigation congress.

142 Newell, Frederick H. Conservation and use of waters in the reclamation of arid lands through governmental agencies. (*In* International congress of applied chemistry. Original communications, Washington, 1912. v. 24: 131-41)

143 —— Electrical features of the U. S. Reclamation service [and discussion] (*In* American institute of electrical engineers. Proceedings. 1914-1915, v. 33: 1583-98; v. 34: 675-9)

[Experience shows that it is practicable for the government to build and operate plants and sell the power at cost]

144 —— Irrigation in the United States . . . Rev. ed. New York, T. Y. Crowell & co. [c1906] 433 p. illus., LXVIII pl.

[Includes information about the Reclamation service]

145 —— Irrigation management; the operation, maintenance and betterment of works for bringing water to agricultural lands . . . New York [etc.] D. Appleton and company, 1916. 306 p.

["The early chapters of this book were prepared as separate articles and printed in substance at least in various engineering publications."—Pref.]

146 —— Making homes in the desert. (*In* The Conquerors. Cleveland, O., 1917. p. 16-36)

147 —— The Reclamation service. (*In* History making, the story of a great nation. Boston, c1910. p. 188-90)

148 Newlands, Francis G. Address to the people of Nevada on water storage and irrigation, 1890. 19 p.

[This pamphlet (maps, diagrams) is now out of print. It marked the beginning of Senator Newland's earnest work in Congress for legislation leading to reclamation of arid lands]

149 Nimmo, Joseph. Uncle Sam's farm. The reclamation of the arid region of the United States by means of irrigation . . . Washington, Gibson bros., printers, 1890. 43 p.

[From Frank Leslie's illustrated newspaper of November 16, November 23, November 30, and December 7, 1889. Thanksgiving series of 1889. Reviews various plans for reclamation of arid lands]

150 Patten, John. A plan for increasing the humidity of the arid region and the utilization of some of the great rivers of the United States for power and other purposes. Communicated to the National irrigation congress, Ogden, Utah, September

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[Text of Federal employees' compensation act, approved Sept. 7, 1916. "This new act is an advantage to the service in regard to the funds for the payment of such claims, because under the former act of May 30, 1908, the compensation provided therein is paid from the Reclamation fund"]

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[Describes first of a series of 1912 conferences of operation and maintenance men]

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[Describes second of a series of 1912 conferences of irrigation managers]

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[Explanation of manner in which the work is conducted]

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[An accurate account of the cost of all its work is kept by the Reclamation service]

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[Tables giving cost of private irrigation projects, Carey act irrigation projects and U. S. reclamation projects]

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[Editorial with table of costs, all projects]

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[Home-making with the aid of the Reclamation service]

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[Tables and conclusions as to relative cost of government vs. private enterprises]

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[Irrigators have insufficient capital, which is absorbed in breaking land, leaving little for stock and equipment]

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["Dispute over water rights between the U. S. Reclamation service and the State of Colorado to be arbitrated by commission of three expert engineers"]

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[A small mine or "country bank" operated by the Reclamation service]

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[This article "presents the cause of a great number of farmers who have settled upon the public domain"]

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[Editorial with extensive quotations from H. T. Cory's paper before American society of civil engineers]

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["Secretary Lane gives increases in areas irrigated, value of crops and number of homes—settlers' success depends on cost of capital"]

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[Information concerning the great water-supply installations west of the Mississippi for the purposes of irrigation]

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[Methods of the U. S. Reclamation service]

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[Extract from Reclamation record concerning the library in the Washington office of the Reclamation service]

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[This article includes a partial list of project women's clubs. It is the first of a series of similar articles, published each month in the Reclamation record for "project women and their interests".]

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[Legal phases of the question]

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[In continuation of the discussion of "What is the matter with irrigation" begun in the editorial columns of the issue of Engineering news for June 12, 1913]

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[Elwood Mead, a well-known American engineer, in charge of extensive irrigation development in Victoria, writes of the factors that have made for success in Australia]

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["Efforts now being made to correct perversion of benefits and to make the reclamation act a real opportunity for the landless homeseeker"]

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[Account of the system with illustrative forms]

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[Account of a field of work new, in some respects, to engineers]

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["The operations of the Reclamation service are of interest to electrical engineers not only in novel developments and applications of power, but also as illustrating the efforts of the federal government in the construction of works of general public utility"]

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[Difficulties of the irrigation manager in dealing with water users]

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[Comprehensive treatment of the water situation in the western states, particular stress being laid upon the economic use of water as the determining factor in its assignment. Illustrations of speculation evils which have occurred under the desert land and Carey acts and of their elimination under the Reclamation act]

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[Some of the problems an irrigation manager has to solve]

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[Address before the National geographic society. Illustrated]

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264 —— What I am trying to do. World's work, Feb. 1913, v. 25: 396-9.

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[Explains the provisions of the Reclamation act and gives an illustrated account of the work in progress]

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[Opposes putting any limitation upon the discretion of the Secretary of the Interior in management of Reclamation service]

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[Statement concerning library of the engineering section of the Washington office, which contains 2000 books and pamphlets, including about 600 volumes of histories of the various projects.]

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273 Reclamation and the east. Outlook, June 20, 1908, v. 89: 393-4.

[Charges the government with unequal distribution of benefits]

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["In the Engineering section of the Washington office a library of over 500 volumes of histories, specifications, engineering investigations, cost data, etc., of the various projects under construction and being operated by the Reclamation service. Many of these volumes are in manuscript and often illustrated with photographs." From Reclamation record, Sept. 1915]

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[Summary of what other countries are doing for their settlers and farmers]

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[The first issued report of the Central board of review supports contention that the bulk of agitation proceeded from speculators and not from the farmers]

283 Shall the irrigation settlers be given relief? Engineering record, Nov. 27, 1915, v. 72: 650-1.

[Considers proposition to give settlers further relief—in addition to the 20-year extension law]

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[Portraits of Messrs. Hitchcock, Newell, and Walcott]

285 Steward, W. G. Some methods of measuring irrigation water practiced by U. S. Reclamation service. Engineering and contracting, Aug. 21, 1912, v. 38: 215-7.

[Delivery of irrigation water to users requires quick and accurate measurement]

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387 Suggested itinerary for engineers desiring to visit reclamation service projects. Engineering news, Feb. 18, 1915, v. 73: 363-4.

288 Swanton, W. I. Engineering reference library. Pacific builder and engineer, Feb. 1916, v. 7: 64.

[United States Reclamation service library]

289 —— Excavation done by U. S. Reclamation service. Engineering record, July 11, 1914, v. 70: 58.

[Diagram shows comparative excavation done by the Reclamation service, the Panama Canal, and the New York State Barge Canal]

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[Hearings showed need for closer supervision by Congress over the expenditures of the Reclamation service]

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[Summary of recommendations made by the Board of army engineers in its report to the President]

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[Special articles by the engineers of the projects]

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[Outlines faults in present system and suggests better methods]

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[Editorial with reference to enlarged scope of "Reclamation record"]

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[Points out some of the good and bad features of federal development]

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[Résumé of results accomplished to June 30, 1914]

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[Work of the Human engineer (particularly the Y. M. C. A. worker) in the construction camps]

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[After interviews with Senator Newlands. Includes account of work of Reclamation service]

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[A story about the Roosevelt dam and charges of mismanagement by the Reclamation service]

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[The Tonto cement plant installed by the Reclamation engineers for use in constructing the Tonto dam in the Salt River Valley]

312 Heard, D. B. Construction [of the Roosevelt dam, Arizona] World today, Oct. 1906, v. 11: 1103-05.

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[For use in making the Roosevelt dam]

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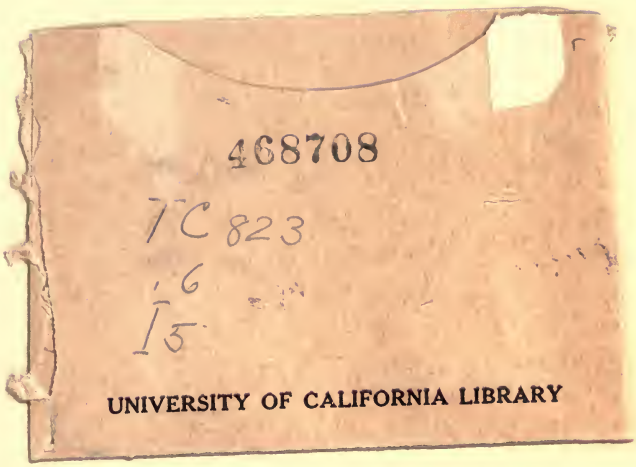
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